

**TM 4-15.21**

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**ARMY WATERCRAFT SAFETY**

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**Headquarters, Department of the Army**

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# Army Watercraft Safety

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## Preface

TM 4-15.21 provides detailed information on guidance and technical information relevant to safety and survival equipment/systems used by United States (U.S.) Army watercraft. The manual contains guidance, instructions, technical data, illustrations, and procedures pertinent to the application, inspection, modification, maintenance, and the use of safety equipment, safety policies, and survival systems. The primary users of this manual are watercraft masters and key personnel engaged in the supervision, operation, or maintenance of U.S. Army watercraft.

The principal audience for TM 4-15.21 is all members of the profession of arms. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army will also use this publication.

Commanders, staffs, and subordinates ensure that their decisions and actions comply with applicable United States, international, and in some cases host-nation laws and regulations. Commanders at all levels ensure that their Soldiers operate in accordance with the law of war and the rules of engagement. (See FM 27-10.).

TM 4-15.21 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which TM 4-15.21 is the proponent publication (the authority) are italicized in the text and are marked with an asterisk (\*) in the glossary. Terms and definitions for which TM 4-15.21 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

TM 4-15.21 applies to the Active Army, Army National Guard/Army National Guard of the United States, and United States Army Reserve unless otherwise stated.

The proponent of TM 4-15.21 is the United States Army Transportation Center and School. The preparing agency is the Combined Arms Support Command (CASCOM) G3 Doctrine Division. Send comments and recommendations on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, United States Army Transportation Center and Fort Eustis, ATTN: ATZF-S (Transportation Corps Branch Safety Office), Joint Base Langley-Eustis, VA 23604-5407.; or submit an electronic DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) (by email to [usarmy.jble.cascom.mbx.marinesafety@mail.mil](mailto:usarmy.jble.cascom.mbx.marinesafety@mail.mil) and to: [usarmy.lee.tradoc.mbx.lee-cascom-doctrine@mail.mil](mailto:usarmy.lee.tradoc.mbx.lee-cascom-doctrine@mail.mil)).

# Introduction

TM 4-15.21, *Army Watercraft Safety*, a single source of guidance and technical information relevant to rescue equipment, survival systems and safety policies used on authorized watercraft by Army watercraft personnel.

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**Note:** Deviations from configurations of equipment presented in this manual are not recommended and are not authorized. To maintain standardization and to preclude the dangers of operating with potentially unsafe equipment, modifications to rescue equipment and survival systems are not authorized.

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This technical manual (TM) contains guidance, instructions, technical data, drawings, illustrations, procedures, and descriptions pertinent to the configuration, modification, application, inspection, fabrication, maintenance and repair, and the use of rescue equipment and survival systems. The Transportation Corps Branch Safety Office, Joint Base Langley-Eustis, VA, will formulate, produce, and distribute applicable changes to the equipment and to respective chapters of this manual.

Because watercraft units have a unique requirement for the specific vessel Annual Safety Survey, commanders will appoint, in writing, a person to manage the unit's Annual Safety Survey program in addition to the duties of the unit safety officer. This individual is responsible for the unit administration and coordination of the safety equipment inspection and maintenance requirements outlined in this manual. This additional duty does not relieve ship's personnel from their duties as it pertains to safety in accordance with Army Regulation (AR) 56-9, *Watercraft*.

Warnings, Cautions, and Notes. The following definitions apply to "WARNINGS," "CAUTIONS," and "NOTES" found throughout this manual.

## WARNING

**Operating or maintenance procedures and techniques that may result in personal injury or loss of life if not carefully followed.**

## CAUTION

Operating or maintenance procedures and techniques that may result in damage to equipment if instructions are not carefully followed.

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**Note:** Operating or maintenance procedures and techniques that are considered essential to emphasize.

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The following definitions apply to the words "shall, will, may," and "should" throughout this manual.

Use of "shall" and "will" indicates a mandatory requirement.

Use of "may" and "should" indicates an acceptable or suggested means of accomplishment.

Regulatory guidance for rescue and survival equipment and systems are contained in AR 56-9. Policies and procedures pertaining to all other aspects of the equipment and systems are stated in this manual.

Allowances of rescue and survival equipment are determined by the type of vessel and mission. Additional equipment may be required to provide for passengers and maintenance. Specific allowances may be found in the appropriate watercraft basic issue items (BII) list.

TM 4-15.21 replaces FM 4-01.502, *Army Watercraft Safety*. The most significant changes are in regard to registration of Emergency Position Indicating Radio Beacons (EPIRB) with the Joint Search and Rescue Satellite-Aided Tracking (SARSAT) Electronic Tracking System (JSETS), added safety precautions for handling distress signal and marker flares, as well as updating personal flotation devices to reflect the proper U.S. Coast Guard series number. Send comments and recommendations on electronic DA Form 2028 by email to: [usarmy.jble.cascom.mbx.marinesafety@mail.mil](mailto:usarmy.jble.cascom.mbx.marinesafety@mail.mil) and to: [usarmy.lee.tradoc.mbx.lee-cascom-doctrine@mail.mil](mailto:usarmy.lee.tradoc.mbx.lee-cascom-doctrine@mail.mil).

TM 4-15.21 contains five chapters and 12 appendices.

**Chapter 1, *Marine Safety Program***, discusses the many components of the marine safety program; safety surveys and inspections, accident reporting, watercraft safety notification and readiness, test drills and inspections, operational readiness, training and watercraft risk management.

**Chapter 2, *Lifesaving Equipment***, discusses in detail the rescue and protective equipment found aboard watercraft. This chapter provides information on a wide range of equipment from personal floatation devices to hard hats. The chapter explains their description, usage and inspection criteria.

**Chapter 3, *Firefighting***, discusses firefighting; the chemistry of fire along with the theory of extinguishment. This chapter provides information on firefighting agents, fixed systems and their limitations, personnel protection, turnout gear, and Self Contained Breathing Apparatus (SCBA). Firefighting techniques will be addressed in appendix J and portable firefighting equipment is addressed in appendix L.

**Chapter 4, *Damage Control Equipment***, lists the objectives of shipboard damage control and describes the equipment used when an emergency occurs at sea.

**Chapter 5, *Global Maritime Distress and Safety System***, provides an overview of the Global Maritime Distress and Safety System (GMDSS) and discusses various emergency communication systems and equipment used.

**Appendix A, *Battery Maintenance***, provides guidance on the proper handling and maintenance of batteries. Because batteries can pose a hazard to soldiers, it is important that they are handled and maintained properly.

**Appendix B, *Eye/Face Wash Station***, outlines the requirements for eye/face wash stations and provides information on where these wash stations should be located.

**Appendix C, *Power Tool Safety***, provides general rules and guidelines for the use and handling of power tools.

**Appendix D, *Color Coding***, identifies the color of the piping system with the corresponding application.

**Appendix E, *Personal Protective Equipment***, provides an overview of the two most common types of personal protective equipment used on Army watercraft; eyewear and gloves.

**Appendix F, *Equipment Guards***, describes the four types of equipment guards and how they are used to prevent injuries.

**Appendix G, *Gangways***, describes the general characteristics of gangways and discusses safety considerations for their use.

**Appendix H, *Lockout / Tagout of Energy Sources***, discusses the lockout/tagout program and details the procedures and responsibilities.

**Appendix I, *Signage***, identifies the two types of signs used and the information they communicate to all personnel onboard.

**Appendix J, *Firefighting Techniques***, provides detailed information on the four fire classifications, their dynamics, and the appropriate extinguishing agent to use for each.

**Appendix K**, *Portable Firefighting and Dewatering Equipment*, identifies the three most common portable fire extinguishers used on Army watercraft and provides detailed information on dewatering equipment. Appendix J also provides a number of dewatering configuration examples.

**Appendix L**, *Confined Space Entry*, lists associated terms, identifies responsibilities, and discusses the various aspects of working in confined spaces.

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## Chapter 1

# Marine Safety Program

The Army's watercraft safety program is designed to help mariners perform their mission in a safe manner and to give the risk level decision maker the necessary military decisionmaking process (MDMP) tools to make informed decisions on the preservation of life and equipment. The program utilizes marine safety surveys, a hazard tracking system, and institutional training to ensure that Army watercraft and the personnel assigned are able to maintain operational readiness and mission effectiveness. Topics covered in this section are:

- Safety Surveys and Inspections.
- Marine Accident Reporting and Investigation.
- Watercraft Safety Notification and Readiness.
- Test, Drills, and Inspections.
- Operational Readiness.
- Training.
- Watercraft Risk Management.

## SAFETY SURVEYS AND INSPECTIONS

1-1. The Transportation Branch Marine Safety Office is assigned the task of performing marine safety surveys to meet the Department of the Army's (DA) triennial requirement. All Army watercraft will undergo a safety survey every three years conducted by the Transportation Corps Branch Safety Marine Safety Office, Joint Base Langley-Eustis, VA., and annually by the battalion or below. Surveys will not be conducted on watercraft in overhaul, underway, in storage or within the first three months after being placed in service. The purpose for the safety survey is to:

- Uphold and maintain the safety posture of Army watercraft as related to readiness.
- Provide compliance with Army and other federal safety regulations.
- Assess the level of safety standardization within the Army watercraft field.
- Provide on-site assistance for crew safety training.
- Accumulate lessons learned from Army watercraft crews.

1-2. Safety survey guides are designed to be generic to vessel classes and are periodically updated as both vessel safety equipment and governing laws/regulations improve. Standardized Safety Guides by vessel Class have been developed and are available from the Transportation Branch Marine Safety Office and the Tank Automotive Command (TACOM)-Unique Logistics Support Applications (TULSA) portal under Safety First. See the references section in the back of this manual for the link to this web site.

## ANNUAL SAFETY INSPECTIONS

1-3. Annual Safety inspections are the responsibility of the commander. Commanders will appoint, in writing, a person to manage the unit's Annual Safety Survey program in addition to the duties of the unit safety officer. This individual is responsible for the unit administration and coordination of the safety equipment inspection and maintenance requirements outlined in this manual. This additional duty does not relieve ship's personnel from their duties as it pertains to safety in accordance with AR 56-9, *Watercraft*. The vessel master is ultimately responsible for insuring vessel inspections and surveys occur as required for their assigned vessel, with special attention to rescue and survival equipment. Battalion level oversight through the use of the Harbormaster Detachment is recommended to provide continuity and consistency across the entire assigned fleet by location.

1-4. Both the public laws and DOD and DA Regulations require safety inspections of each watercraft to be performed within specific time frames. Public law requires annual inspections be performed by the owning organization and periodic inspections by law enforcement agencies of the national flag of the vessel. DA regulations require an annual safety inspection of all equipment and facilities managed/owned by each specific command. Additionally, DOD regulations require a triennial safety inspection of all vessel equipment and management processes be conducted by a major component command level. The Army has assigned this task to Commander, Training and Doctrine Command, who further assigned the task to the Chief of Transportation.

### DEFICIENCIES FOUND DURING SAFETY SURVEYS AND INSPECTIONS

1-5. Deficiencies identified during triennial watercraft safety surveys and inspections are itemized and forwarded on a memorandum for record to the responsible unit via the chain of command. These deficiency memorandums are written by the Transportation Branch Marine Safety Office and issued by the Chief of Transportation. A written response from the responsible unit to the Transportation Branch Marine Safety Office for the Chief of Transportation that states the action taken for each deficiency and must be provided by endorsement via the chain of command. The reply will be arranged so that the response for each deficiency indicates the date for the correction and a summary of corrective action. Generic “corrective action was taken” entries are not acceptable. Specific named personnel should be assigned responsibility to ensure completion of uncorrected tasks together with expected dates of completion. Items identified as “on order” must be referenced with a document control number, date, and status. Deficiency corrections identified by a “work order” must have work order number, status, and dates provided. If a correction is shown as deferred until On-Condition Cyclic Maintenance, an explanation must be given for the deferment with a date of the On-Condition Cyclic Maintenance period. Correction specifics should first state the deficiency in italic font as written in the Chief of Transportation’s memorandum followed by the corrective action taken. The following is an example of a deficiency and the corrective action taken.

#### *NAVIGATION SAFETY EQUIPMENT*

**Deficiency** - Vessel has the latest version of local operating area chart 12248, but no corrections have been made. There are 81 individual corrections needed per United States Coast Guard (USCG) Local Notice to Mariners and NGA Notice to Mariners prior to getting underway.

**Corrective Action** – Chart 12248 was corrected up to date on 15 July for all the latest Notice to Mariners and Weekly Notice to Mariners.

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*Note.* Only the deficiency description from the Chief of Transportation needs to be repeated if the entry contains additional details and guidance.

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### MARINE ACCIDENT REPORTING AND INVESTIGATION

1-6. An Army accident is defined as an unplanned event or series of events. For watercraft, these events could result in one or more of the following.

- Accidents occurring while loading, off-loading, or receiving services dockside.
- Damage to Army property (including government-furnished material, government property, or government-furnished equipment provided to a contractor).
- Accidents occurring during amphibious operations or on-shore warfare training.
- Injury (fatal or nonfatal) to on or off duty military personnel.
- Injury (fatal or nonfatal) to on-duty Army civilian personnel. Includes non-appropriated fund civilians and foreign nationals employed by the Army when incurred during performance of duties while in a work-compensable status.
- Occupational injury or illness (fatal or nonfatal) to Army military personnel, Army civilian, non-appropriated fund civilians, or foreign nationals employed by the Army.
- Injury or illness (fatal or nonfatal) to non-Army personnel or damage to non-Army property.

1-7. A report is defined as the initial notification process--informing the chain of command and other required parties in the time frames prescribed that an Army defined accident has occurred.

1-8. Recording is the actual completion of the required form(s) (DA Form 285 [*Technical Report of U.S. Army Ground Accident*] or DA Form 285-AB [*U.S. Army Abbreviated Ground Accident Report (AGAR)*]), part of the appointed Accident Investigating Officer's requirements.

1-9. The types of watercraft under the jurisdiction of the DA are those that are:

- Operated, controlled or directed by the Army. This includes watercraft furnished by a contractor or another Government agency when operated by Army watercraft personnel.
- Loaned or leased to non-Army organizations for modification, maintenance, repair, test, and contractor, research, or development projects for the Army.
- Under test by Army agencies responsible for research, development, and test of equipment.
- Under operational control of a contractor for the Army.

1-10. This chapter does not negate the Vessel Master's responsibility to report any applicable marine accident, injury, or death involving commercial or government-owned watercraft or property to the U.S. Coast Guard.

## REPORTING IMPORTANCE

1-11. Army accidents are reported and investigated to identify problem areas (deficiencies) as early as possible in order to save personnel and equipment. Changes, corrections, and countermeasures can be developed and implemented to these deficiencies before people are hurt or killed or equipment is damaged, destroyed, or lost. If an accident is never reported, the local command and required Department of the Army Agencies will not know there is a problem. Unreported accidents lead to repeat occurrences. Accidents must be addressed to prevent future loss of man-hours, life and equipment. Reporting and investigating Army accidents in a complete and timely manner is an extremely important function. Procedures for watercraft accident investigation and written reports are outlined in AR 56-9 and DA Pamphlet 385-40.

## MASTER/OPERATOR REPORTING RESPONSIBILITIES

1-12. If an Army watercraft is involved in an accident, the master/operator must report the accident (initial notification) via any electronic means available, within 24 hours of the occurrence to their local command, commands of concern, to U.S. Army Combat Readiness Center (CSSC-O), Fort Rucker, AL 36362-5363, DSN 312-558-2660, COM (334) 255-2660, and to the Transportation Corps Branch Marine Safety Office, DSN 312-826-1327, COM (757) 878-1327, in accordance with AR 385-10 and DA PAM 385-40. If not previously reported by the vessel master / operator, the local command has the responsibility, per AR 385-10; DA Pam 385-40 and AR 56-9, to pass on (notify) these reported occurrences to the Transportation Corps Branch Safety Office at [usarmy.jble.cascom.mbx.marinesafety@mail.mil](mailto:usarmy.jble.cascom.mbx.marinesafety@mail.mil) and the Commander, USACRC. The primary method for immediate notification is through the Web-based initial notification tool located on the USACRC Web site. The USACRC web address is provided in the references section in the back of this manual. DA Form 7306 (*Worksheet for Telephonic Notification of Ground Accident*) is necessary for compiling ground accident information to complete the initial notification tool report. The secondary method for immediate notification is by telephone Defense Switched Network 312-558-2660/558-3410, Commercial (334) 255-2660/255-3410. At a minimum, notification will include the information on DA Form 7306 which can be downloaded from the Army Publishing Directorate (APD) website. See AR 385-10 and DA Pamphlet 385-40 for an example of a completed form. Reporting by phone or using the initial notification tool meets the requirement for reporting within 24 hours. The master/operator does not report using the DA Form 285 report. This chapter does not negate the master's responsibility to report any applicable watercraft accident, injury, or death involving commercial watercraft or property to the U.S. Coast Guard; or the U.S. Coast Guard's responsibility to investigate a watercraft-related accident.

## ACCIDENT REPORTS

1-13. Army investigated accidents must be recorded on the appropriate forms. Currently this is DA Form 285. The recorded report is prepared by the appointed Investigating Officer according to DA Pamphlet 385-

40 requirements. Only a commander in the chain of command can appoint the Accident Investigating Officer. This report is intended only for accident prevention purposes and will not be used for administrative or disciplinary actions within the DOD.

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**Note.** To inform the Investigating Officer of marine-related information pertinent to the investigation, the following additional information will be included in DA Form 285 as an enclosure:

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- Time and place of commencement of voyage and destination.
- Current (direction and force).
- Wind (direction and force).
- Visibility in yards.
- Tide and sea conditions.
- Name of person in charge of navigation and persons on the bridge.
- Name and rank of lookout and where stationed.
- Time when bridge personnel and lookouts were posted on duty.
- Course and speed of watercraft.
- Number of passengers and crew on board.
- Names of crew and passengers.
- Copies of all pertinent log entries.
- List of the names and addresses of witnesses.
- When steering gear and controls were last tested.
- When and where compasses were last adjusted and the magnetic deviation, if any, at time of accident.
- Statement of any outside assistance received.
- Diagrams of damage and pertinent documents.
- Photos of damage.
- Any further details not covered above.

### RECORDABLE (INVESTIGATED) ACCIDENTS

1-14. It is mandatory that all Army accidents are reported, regardless of class, to the local activity or installation safety office. However, only recordable (investigated) accidents require completion and submission of DA Form 285. These recordable accidents include Classes A, B, and Aviation Class C accidents (see AR 385-10 for details). The Army classifies recordable accidents by severity of injury and property damage. These classes of recordable accidents (A through D) are used to determine the appropriate investigative and reporting procedures, and are described below.

#### Class A

1-15. The total cost of reportable damage is \$2,000,000 or more. An Army aircraft, watercraft, missile, or spacecraft is destroyed, missing or abandoned; or an injury / occupational illness results in a fatality or permanent total disability.

#### Class B

1-16. The total cost of reportable property damage is \$500,000 or more, but less than \$2,000,000. An injury and/or occupational illness results in permanent partial disability; or three (3) or more people are hospitalized as inpatients as the result of a single occurrence.

#### Class C

1-17. The total cost of property damage is \$50,000 or more, but less than \$500,000. A nonfatal injury or occupational illness that causes one (1) or more days away from work or training beyond the day or shift on

which it occurred; or a disability at any time (that does not meet the definition of class A or B and is a lost time case).

### **Class D**

1-18. The cost of property damage is \$2,000 or more, but less than \$50,000; a nonfatal injury or illness resulting in restricted work, transfer to another job, medical treatment greater than first aid, needle stick injuries and cuts from sharps that are contaminated with another person's blood or other potentially infectious material, medical removal under medical surveillance requirements of an Occupational Safety and Health Administration (OSHA) standard, occupational hearing loss, or a work-related tuberculosis case.

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*Note.* Property damage is defined as the cost to repair or replace to original condition. Property damage costs are separated from personnel injury/illness costs for classifying A through C accidents.

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1-19. For Army accidents that require a DA Form 285, the commander having general court-martial jurisdiction over the installation or unit responsible for the operation, personnel or materiel involved in the accident will make sure of the following:

- Appoint an Investigating Officer and any support technical assets required.
- An investigation is performed to obtain the facts and circumstances of the accident for accident prevention purposes only (DA Pam 385-40).
- Collateral investigations are used to obtain and preserve all available evidence for use in litigation, claims, disciplinary action, or adverse administrative actions. They are essential for the protection of the privileges afforded to accident investigation reports, as they ensure there is an alternative source of evidence for use in legal and administrative proceedings. Although non-privileged information acquired by a safety accident investigator shall be made available to the collateral investigation, the latter is conducted independently and apart from other types of accident investigations.
- Evidence is preserved in accordance with DA Pam 385-40.
- Personnel interviewed during an Army Accident Investigation do not fill out or sign any Sworn Statements. All statements are recorded in the Investigating Officer's handwriting and the third person.
- DA Form 285 is completed according to instructions on the form and DA Pamphlet 385-40. The form must be forwarded through the installation safety office to the Army Safety Center and the Transportation Branch Marine Safety Office for recording in the Army Safety Management Information System within 30 days of the accident. Army Reserve reports are sent to the Army Reserve Safety Directorate at this address: Commander, U.S. Army Reserve Command, ATTN: AFRC-SA, 4710 Knox St. Fort Bragg, NC 28310-0001.
- See DA Pamphlet 385-40 for accidents that require a board investigation.

### **COLLATERAL INVESTIGATION REPORTS**

1-20. A collateral investigation report is required in many cases for class A, B, or C accidents to make and preserve a record of the facts for litigation, claims, and disciplinary and administrative actions. These investigations are conducted in accordance with AR 15-6 and not the procedures in DA Pamphlet 385-40. A collateral investigation is required on all fatal accidents. It is also required for those accidents that generate a high degree of public interest or are likely to result in litigation for or against the government. Releasing or sharing information gathered under an accident investigation or a collateral investigation must be strictly controlled in accordance with (IAW) DA Pam 385-40. Additionally, before sharing information gathered under a collateral investigation, check with the servicing judge advocate to ensure the release is proper. The appointed accident investigation officer cannot also be appointed as a collateral investigation officer on the same accident.

## **WATERCRAFT SAFETY NOTIFICATION AND READINESS**

1-21. Listed below are the notification and readiness messages relevant to Army watercraft. These notifications and messages can be found on the TACOM-Unique Logistics Support Applications (TULSA) portal under Safety First. The link to this web site can be found in the references section of this manual.

1-22. IAW AR 750-6 Army Equipment Safety and Maintenance Notification System there are two types of messages Safety and Maintenance. Safety Messages include Safety of Use (SOU) Message and Ground Precautionary Action (GPA) Messages. Maintenance Messages include Maintenance Action (MA) Messages and Maintenance Information (MI) Messages.

### **ARMY EQUIPMENT SAFETY AND MAINTENANCE NOTIFICATION SYSTEM MESSAGE DEFINITIONS**

1-23. Safety of Use (SOU) Message. High-priority notification pertaining to any defect or hazardous condition or combinations of actions, actual or potential, that can cause personal injury, death, or damage to equipment, related system, components or repair parts where a medium to high risk determination (safety condition) has been made per DA Pam 385-16 or an Army approved risk matrix MIL-STD-882D. SOUs are classified into three sub-categories (Emergency, Operational, and Technical).

- Emergency SOU. Emergency messages will immediately (non-mission capable (NMC)) ground equipment of an entire fleet or a designated portion of a Mission Design Series (MDS) fleet.
- Operational SOU. An operational message restricts specific performance capabilities in the instance of an MDS or MDS Model (MDSM) fleet or fleets fitted with special mission equipment.
- Technical SOU. A technical message may be released to implement (NMC) ground equipment because of workmanship or related material defect conditions.

1-24. Ground Precautionary Action (GPA) message. A message that conveys equipment maintenance, technical or general interest information where a low to medium risk safety condition has been determined per DA Pam 385-16. GPAs are classified into three sub-categories (Maintenance Mandatory, Operational, and Informational).

- Maintenance Mandatory GPA. A maintenance mandatory message directs maintenance actions and/or updates technical manuals and may also require compliance reporting and task/inspection reporting.
- Operational GPA. An operational message pertains to equipment operation, procedures, limitations or operational policy.
- Informational GPA. An informational message provides status and information of maintenance, technical or general nature.

1-25. Maintenance Action (MA) message. MA messages are those that convey maintenance, sustainment, logistics supply, technical, operational or general maintenances, or sustainment interest information that is not related to safety concerns, issues or risks, hazards, or risk mitigation. Mitigation of safety related issues are "NOT" contained in MA messages. MAs are classified into three sub-categories (Maintenance Mandatory, Operational, and Informational). MA messages will be released to provide the following types of information to the field when the releaser requires an action to be performed and/or a return receipt is desired.

- Maintenance Mandatory MA. A maintenance mandatory message directs maintenance actions and/or updates technical manuals and may also require compliance reporting and task/inspection reporting.
- Operational MA. An operational message pertains to equipment operation, maintenance procedures, maintenance limitations or maintenance policy.
- Informational MA. An informational message provides status and information of maintenance, technical or general nature.

1-26. Maintenance Information (MI) message. MI messages convey general interest information that is permissive in nature. MI messages do not require the recipient to perform a required action or respond with any required information. The same three sub-categories above under MA, paragraph 1-24, apply to MIs.

### **Watercraft Safety Advisory/Alert Messages**

1-27. .Watercraft Safety Advisory Messages. These messages can be found on the TULSA portal under the Safety First link which is provided in the references section in the back of this manual.

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*Note.* For additional information refer to AR 750-6, AR 385-10 as well as the Integrated Logistics Support Center web site. See the reference section in the back of this manual for the link to this site.

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### **STANDARDIZED PRODUCTS**

1-28. The field maintains standardized equipment for the mariner to use. This is found in the BII listing onboard the vessels and must be inspected at specified intervals. The inspections are used to identify equipment for serviceability; any items found to be unserviceable or obsolete will be removed from the inventory immediately. These items include, but are not limited to life saving equipment and emergency equipment.

## **TEST DRILLS AND INSPECTIONS**

1-29. The test drills and inspections required for Army watercraft are listed below.

### **PRE-ACCIDENT OR PRE-EMERGENCY PLANNING**

1-30. Prior to vessel or plant deployment, plans shall be prepared for response to marine emergencies such as fire, sinking, flooding, severe weather, man overboard, and hazardous material (HAZMAT) incidents as outlined by USCG guidance. Drills and exercises of these plans shall be conducted as stated in the guidance.

### **EMERGENCY DRILLS**

1-31. Drills must be held in accordance with AR 56-9. Additionally, drills must be held before sailing when a vessel enters service for the first time, after modification of a major characteristic, or when a new crew is engaged.

1-32. Abandon-ship drills must include summoning persons on board to muster stations with the general alarm followed by drill announcements on the public address or other communication system and ensuring that the persons on board are made aware of the order to abandon ship, reporting to stations and preparing for the duties described in the station bill, checking that persons on board are suitably dressed, checking that lifejackets or immersion suits are correctly donned.

1-33. Each fire drill must include reporting to stations and preparing for the duties described in the station bill for the particular fire emergency being simulated.

1-34. Every crewmember must be given instructions that include, but are not limited to:

- The operation and use of the vessel's inflatable life rafts, the problems of hypothermia, first aid treatment for hypothermia, and other appropriate first aid procedures.
- Any special instructions necessary for use of the vessel's lifesaving appliances in severe weather and severe sea conditions, and the operation and use of both fixed and portable fire-extinguishing appliances.

## **RECORDS**

1-35. When a muster is held, details of abandon-ship drills, fire drills, drills with other lifesaving appliances, and onboard training must be recorded in the vessel's official logbook. Logbook entries must include at a minimal the date and time of the drill, muster, or training session, the survival craft and fire-extinguishing equipment used in the drill or drills, Identification of inoperative or malfunctioning equipment and the corrective action taken, identification of crewmembers participating in drills or training sessions, and the subject of the onboard training session.

1-36. If Tests, Drills, and Inspections are not held within the appointed time, an entry must be made in the logbook stating the circumstances and the details of why the event did not take place.

1-37. Once a month, if a vessel carries immersion suits or anti-exposure suits, the suits must be worn by crewmembers in at least one abandon-ship drill. If wearing the suits is impracticable due to warm weather, the crewmembers must be instructed on their donning and use.

## **OPERATIONAL READINESS**

1-38. Before the vessel leaves port and at all times during the voyage, each lifesaving appliance must be in working order and ready for immediate use.

## **MONTHLY INSPECTIONS**

1-39. Each lifesaving appliance, including life raft equipment, must be inspected monthly to make sure the appliance and the equipment are complete and in good working order. A report of the inspection, including a statement as to the condition of the equipment, must be recorded in the vessel's official logbook. Each Emergency Position Indicating Radio Beacon (EPIRB) and each Search and Rescue Transponder (SART), other than an EPIRB or SART in an inflatable life raft, must be tested monthly. The EPIRB must be tested using the prescribed testing functions or features recommended by the manufacturer. Supervisors must ensure that during testing the EPIRB and SART are not activated outside of the test circuit, failure to do so may result in an inadvertent alert for response sent to the USCG or surrounding vessels

1-40. Dry Chemical Fire Extinguishers are also required to be inspected monthly. Listed below are the requirements to conduct this inspection.

- Check to ensure the dry chemical fire extinguisher is located in its designated place and mounted with proper brackets (if applicable).
- Check to ensure that there is no obstruction to prevent access or visibility (for example, in a wall locker).
- Check pressure gauge reading or indicator in the operable range or position.
- Check operating instructions on nameplates and ensure that they face outward and are legible.
- Check safety seals and ensure pull pins are intact.
- Invert fire extinguisher and shake to keep the chemical powder from becoming packed at the bottom.
- Check for obvious physical damage, corrosion, leakage, or clogged nozzle.
- Check Hazardous Material Identification System to ensure it is present on the extinguisher and legible.
  
- Check for serviceability with an internal inspection or with hydrostatic testing.
- Check to ensure that the extinguisher and its location are numbered correctly with the fire control plan.

## **ANNUAL INSPECTIONS**

1-41. Annual inspections must include but are not limited to the following:



- Commanders must perform an annual safety inspection on all vessels within their command. The unit must keep the annual safety inspection on file for three years and provide copies of the previous annual inspections to the Marine Safety Office during the Triennial Watercraft Safety Survey.
- Each davit, winch, fall, and other launching appliance must be thoroughly inspected, and repaired, as needed, once each year.
- Each item of survival equipment with an expiration date must be replaced during the annual inspection if the expiration date has passed, or if items in kit sets or sub-components to equipment will expire during the coming year. Date the next service/inspection as due when sub items to equipment will expire.
- Each battery is clearly marked with an expiration date and used in an item of survival equipment must be replaced during the annual inspection if the expiration date has passed. If items in kits, sets or sub-components to equipment will expire during the coming year, date the next service/inspection as due when sub items to equipment will expire.
- Except for a storage battery used in a rescue boat, each battery without an expiration date that is used in an item of survival equipment must be replaced during the annual inspection.
- Life raft release gear must be operationally tested under a load of 1.1 times the total mass of the life raft when loaded with its full complement of persons and equipment whenever overhauled or at least once every 5 years.
- Perform Conductivity Test on portable carbon dioxide (CO<sub>2</sub>) fire extinguisher insulated nozzle horn.

1-42. Each vessel will record tests, drills and inspections accomplished IAW AR 56-9, table 2-1.

### **On Demand**

1-43. On demand inspections include the following:

- Vessel pre-sail Checks.
- GMDSS Equipment Pre-Departure test.
- Petroleum, oil, and lubricant (POL) Transfers to/from Vessel.
- Garbage Removal.
- Passenger Safety Briefing (prior to getting underway when carrying passengers).
- Self-Contained Breathing Apparatus (SCBA) air sample testing for each cylinder refill.

### **Weekly**

1-44. Weekly inspections include:

- Emergency Power and Lighting test while vessel is operational.
- General Alarm test.
- Ships Whistle test.
- Fire Drill.
- Abandon Ship Drill.
- Survival Craft Radio (SCR) test while vessel is operational.
- Search and Rescue Transponder (SART) test while vessel is operational.

### **Monthly**

1-45. Monthly inspections include:

- Emergency positioning indicating radio beacon (EPIRB) test.
- Portable fire extinguishers inspected.
- Portable dewatering pump test.
- Confined space entry meter calibrated and inspected.
- Emergency generator two hour load test.

- SART test.
- Portable eyewash station and inspection.
- Ship sanitation inspection.
- Man Overboard Drill.

### **Quarterly**

1-46. Quarterly inspections include the following:

- Line throwing device test.
- SCBA inspection.
- Immersion suit drill and inspection.
- Rescue boat test.
- Portable blower test.
- Breathing air compressor air sample testing.

### **Semi-Annually**

1-47. Semi-annual inspections include the following:

- Emergency batteries test.
- Life ring water lights test.
- Litter slings load certification renewal.
- Battery operated flashlights and battle lanterns test.

### **Annually**

1-48. Annual inspections include the following:

- Command watercraft safety inspection.
- Personal flotation device and attachments inspection.
- Fire main pressure test.
- Fire and foam hoses pressure test.
- Fire/smoke detection system inspection.
- Ground tackle inspection.
- Crane Occupational Safety and Health Administration (OSHA) accredited inspection.
- Rescue boat slings OSHA accredited inspection.
- SCR test.
- Magnetic compass deviation table renewal.
- Fixed fire extinguishing system inspections.
- Fire fighter's ensemble inspection.
- Life rings inspections.
- First aid kits inspection and component renewal.
- Commercial life raft certification and renewal.
- Emergency breathing devices inspection.
- Confined space entry test.
- Galley range extinguishing system certification renewal.
- Load Line Certification endorsement.
- Military pyrotechnics serviceability Quality Assurance Specialist (Ammunition Surveillance) (QASAS) inspection.
- Fuel transfer hose static liquid pressure test.

## Bi-Annual

1-49. Bi-annual inspections include the following:

- Remote control valves test.
- EPIRB hydrostatic release replacement and certification.
- Foam tanks contents test.
- Sprinkler systems test.
- Nuclear, biological, and chemical (NBC) sprinkler system test.

## Triennially

1-50. Triennial inspections will be conducted on the following:

- Ship Radio Authorization (SRA) renewal.
- Marine Safety Office Watercraft Safety Survey.
- Scott testing system functional test on SCBA using test stand.

## 5th Year

1-51. The items listed below will be inspected on the five year inspection:

- Navy life raft certification renewal.
- Thanner DK84.1-M life raft hydrostatic release certification renewal.
- Hydrostatic test on portable fire extinguisher CO2 bottles.
- Hydrostatic test on SCBA cylinders.

## 6th Year

1-52. The six year inspection will include the internal inspection of Dry Chemical portable fire extinguishers.

## 12th Year

1-53. The 12 year inspection will include the following:

- Compressed gas bottle hydrostatic certification (maximum).
- Hydrostatic test on or replacement of Dry Chemical portable fire extinguishers.

## PASSENGER SAFETY BRIEFING

1-54. Passengers and special personnel must be instructed in the use of the lifejackets and the actions to take in an emergency. Whenever new passengers or special personnel embark, a safety briefing must be given immediately before sailing. The announcement must be made on the vessel's public address system or by other equivalent means likely to be heard by the passengers and special personnel. The briefing may be included in the muster if the muster is held immediately upon departure.

## POSTED DOCUMENTS AND REQUIRED PUBLICATIONS

1-55. Every class A vessel will carry on board all Department of the Army (DA) regulations, technical manuals (TM), technical bulletins (TB), and field manuals (FM) cited in AR 56-9, Appendix A.

1-56. Every unit with assigned class B or C vessels will maintain publications cited in AR 56-9, appendix A. Documents will be posted as specified in table 1-1 on page 1-12.

**Table 1-1. Document posting areas**

<b>Document</b>	<b>Posting Requirement</b>
Fire Control and Emergency Equipment plan	Engine room Common areas (e.g. passage ways, mess decks) Bridge
Load Line Certificate	Bridge

**Table 1-1. Document posting areas**

<b>Document</b>	<b>Posting Requirement</b>
Lifesaving Signals	Bridge Common areas (e.g. passage ways, mess decks)
Station Bill (complete and current)	Engine room, Common areas (e.g. passage ways, mess decks), Bridge
Pollution Placards	Engine room, Common areas (e.g. passage ways, mess decks)
Fixed Firefighting System warnings, instructions	At firefighting equipment
Emergency Steering Instructions	On Bridge and at Emergency Steering Station.
Fixed Foam Extinguishing Systems	At activating remote station.
Officers Licenses	Bridge
Radio Frequency Authorization	On the bridge near main radio transmitter
Two GMDSS Radio Operator's Certificate/ Endorsement	Bridge
Bridge Global Maritime Distress and Safety System (GMDSS) Operators Guidance for Ships in Distress (International Maritime Organization 969E)	Bridge ,Each Army vessel outfitted with GMDSS on bridge near main radio transmitter
Wheelhouse Poster	Bridge

## **LOGS AND RECORD BOOKS**

1-57. Log and Record books appropriate for the craft are maintained on each vessel. This includes, but is not limited to Deck and Engine logs, Communications logs, Trash logs and Oil Record Books. Actions will be recorded as required in AR 56-9, chapter 6. This insures accountability for vessel missions and for regulatory requirements and provides a historical record. If scheduled tests, drills and inspections cannot be conducted on an operational vessel for any reason, it must be documented in the log.

## **FIRE CONTROL PLANS**

1-58. Fire control plans provide the vessel firefighting teams with detailed information of vessel layout. This information gives the damage control team strategic options for an aggressive interior attack during a ship board fire. There are standard icons used in the development of a Fire control plan aboard watercraft. See figure 1-1 on pages 1-13 and 1-14 for the Master Firefighting and Safety Equipment List currently used aboard Army watercraft.



























































MASTER FIREFIGHTING & SAFETY EQUIPMENT LIST			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	A-CLASS BULKHEAD		FIRE ALARM STROBE
	A-CLASS FIRE DOOR: WTRTT, SLIDING, SELF CLOSING		FIRE AXE
	AIR COMPRESSOR FOR SCBA		FIRE CONTROL AND EMERGENCY EQUIPMENT PLAN
	ANTI-EXPOSURE SUIT		FIRE DETECTION AND ALARM CONTROL PANEL
	B-CLASS BULKHEAD		FIRE EXTINGUISHER, PORTABLE, CO2 15-LB
	BATTLE LANTERN (HARD WIRED)		FIRE EXTINGUISHER, PORTABLE, DRY CHEM B-C SIZE II
	BILGE PUMP #1 (EMERGENCY) REMOTE CONTROL		FIRE EXTINGUISHER, PORTABLE, DRY CHEM 5-LB
	BILGE PUMP (OILY) REMOTE CONTROL		FIRE EXTINGUISHER, PORTABLE, DRY CHEM 10-LB
	BLOWER, WATER OR ELECTRIC DRIVEN		FIRE EXTINGUISHER, PORTABLE, DRY CHEM 20-LB
	CONFINED SPACE ENTRY OXYGEN METER		FIRE HYDRANT 2-1/2" NH
	COUNTER MEASURES WASHDOWN SPRAY NOZZLE		FIRE MAIN ISOLATION VALVE
	COUNTER MEASURES WASHDOWN SYSTEM VALVE		FIRE MONITOR WATER/FOAM
	DETECTOR, HEAT, 135 DEGREES		FIRE MONITOR PUMP
	DETECTOR, HEAT, 190 DEGREES		FIRE MON. or FIRE PMP #2 (BLST) REMOTE CTRL
	DETECTOR, SMOKE		FIRE PUMP #1 (EMERGENCY FIRE PUMP)
	EDUCTOR AND OUTFITTING		FIRE PUMP #1 (EMERGENCY) REMOTE CONTROL
	ELECTRICAL REPAIR KIT		FIRE PUMP #2 (BALLAST)
	EMERGENCY BATTERIES		FIRE STATION
	EMERGENCY ESCAPE BREATHING DEVICE		FIREFIGHTER'S ENSEMBLE OUTFIT
	EMERGENCY GENERATOR		FIRST AID KIT
	EMER POSITION-INDICATING RADIO BEACON (EPIRB)		FIXED FIRE EXTINGUISHING BANK: FM-200
	EMERGENCY SWITCHBOARD		FIXED FIRE EXTINGUISHING CYLINDER (SINGLE): FM-200
	ENGINE EMERGENCY SHUTDOWN, BOW THRUSTER		FIXED FIRE FIGHTING SYSTEM BELL: FM-200
	ENGINE EMERGENCY SHUTDOWN, EMERG GEN		FIXED FIRE FIGHTING SYSTEM ELECTRIC HORN/STROBE
	ENGINE EMERGENCY SHUTDOWN, GENERATOR		FIXED FIRE FIGHTING SYSTEM GAS SIREN
	ENGINE EMERGENCY SHUTDOWN, MAIN ENGINE		FIXED FIRE FIGHTING SYSTEM PULL STATION: FM-200
	ESCAPE ROUTES (PRIMARY)		FOAM CONCENTRATE AFFF 5-GAL
	FIRE ALARM BELL		FOAM PORTABLE APPLICATOR
	FIRE ALARM PULL STATION		FOAM SUPPLY VALVE

Figure 1-1. Master firefighting &amp; safety equipment list


























































MASTER FIREFIGHTING & SAFETY EQUIPMENT LIST			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MAN OVERBOARD INDICATOR DIRECTION FINDER		RESCUE/WORK BOAT
	MAUL 5-LB TYPE 12		RING BUOY WITH LIGHT
	P-100 PUMP		RING BUOY WITH LINE
	PERSONAL FLOTATION DEVICE (PFD) TYPE I		ROLLING FIRE DOOR (RFD) GALLEY
	PIPE REPAIR KIT		ROTATING BEACON, AMBER (FM-200)
	PUMP SUBMERSIBLE		ROTATING BEACON, GREEN (MN ENG ALARM)
	PYROTECHNIC LOCKER		ROTATING BEACON, RED (GENERAL ALARM)
	REMOTE CONTROL FOR WATERTIGHT DOOR		SCBA BOTTLES
	RESCUE TRIPOD		SCBA OUTFITS
	FOAM SUPPLY VALVE REMOTE CONTROL		SEARCH AND RESCUE TRANSPONDER (SART)
	FREON ALARM PANEL		SHORING, ADJUSTABLE STEEL
	FREON REFRIGERANT GAS DETECTOR		SIGNAL, DISTRESS, COMBO SMOKE & ILLUMINATION
	FUEL OIL PUMP SHUTDOWN, REMOTE		SIGNAL, DISTRESS, RED PARACHUTE FLARE
	FUEL OIL VALVE SHUTDOWN, REMOTE		SPACE PROTECTED BY FM-200
	GALLEY HOOD R-102 CYLINDER IN PROTECTED AREA		STRETCHER, NEIL ROBERTSON
	GALLEY HOOD R-102 PULL STATION		STRETCHER, STOKES
	GENERAL ALARM BELL		SURVIVAL CRAFT RADIO
	GENERAL ALARM CONTACT MAKER		THERMAL PROTECTIVE AID
	GENERAL ALARM LOUDSPEAKER		VENT FIRE CLOSURE: ACCOM & SVCE SPACES
	HYDROGEN FLOURIDE (HF) GAS DETECTION KIT		VENT FIRE CLOSURE: MACHY SPACES
	HYDROGEN FLOURIDE (HF) GAS SAMPLING PORT		VENT FIRE DAMPER: ACCOM & SVCE SPACES
	IMMERSION SUIT		VENT FIRE DAMPER: MACHY SPACES
	INTERNATIONAL SHORE CONNECTION		VENT FIRE DAMPER REMOTE: ACCOM & SVCE SPACES
	LIFERAFT (25 PERSON), INFLATABLE		VENT SHUTDOWN REMOTE: ACCOM & SVCE SPACES
	LINE THROWING DEVICE		VENT SHUTDOWN REMOTE: MACHY SPACES
	LOCATION MARKER - SMOKE		VERTICAL LADDER
	LUBE OIL PUMP SHUTDOWN, REMOTE		WATER-JET FIRST AID BURN TREATMENT
	LUBE OIL VALVE SHUTDOWN, REMOTE		WATER WASHDOWN PROTECTED SPACE
			WATER WASHDOWN SYSTEM CONTROL VALVE

Figure 1-1. Master firefighting &amp; safety equipment list (continued)

## PILOT CARD

1-59. This card is required by International Maritime Organization (IMO) Resolution Assembly.601 (15) and provides the information mandated by Code of Federal Regulations (CFR) for information exchange between a vessel master and pilot. The pilot card presents in a brief form the current conditions of the ship with regard to its propulsion, steering equipment and loading conditions. The pilot card can be locally produced, and should be filled out by the ship's master prior to arrival of the pilot onboard.

## WHEELHOUSE POSTER

1-60. The wheelhouse poster is required by IMO Resolution A.601 (15) and Title 33 CFR 164.35. It provides more complete information concerning ship hull and engine characteristics than the pilot card. It contains information on stopping distances, turning diameters, and trajectories for entering turns at the maximum rudder angle in loaded and ballasted conditions. Use of the standardized wheelhouse poster is helpful in presenting the required information in a form that is readily recognizable by operating personnel and pilots unfamiliar with the vessel.

## STATION BILL

1-61. Army watercraft use standardized emergency signals beyond the legally required signals to communicate both interior to the vessel and external to other vessels. The following are the specific signals

and instructions which are part of the vessel's station bill which is required to be posted in various areas throughout the vessel. See table 1-2 below and continuing on page 1-16.

**Table 1-2. Station bill instructions**

<b>Type of Emergency</b>	<b>Corresponding Signal</b>
Fire and Damage Control	Continuous sounding of the ship's whistle and the general alarm for not less than 10 seconds.
Battle Stations	Multiple Short Rings for a period of at least 30 seconds on the General Alarm followed by the announcement "General Quarters, Man Your Battle Stations"
Man Overboard	Hail and Pass the word to the bridge, raise international code flag "Oscar" and pass the announcement "Man Overboard"
Abandon Ship	More than 6 short (1 second) blasts and 1 long blast (not less than 10 seconds) on the ship's whistle and general alarm. Followed by the announcement "Abandon Ship"
Sea and Anchor Detail	The passing of the announcement "Set Sea and Anchor Detail"
Chemical, Biological, Radiological, and Nuclear (CBRN) Stations	Multiple Short Rings for a period of at least 30 seconds on the General Alarm followed by the announcement "CBRN Stations"
Collision	Sounding of 5 short rings on the ship's General Alarm and whistle followed by the announcement "Prepare for Collision"
<b>Instructions</b>	
<b>General:</b> <ol style="list-style-type: none"> <li>1. Establish Personnel Accountability.</li> <li>2. Entire crew shall familiarize themselves with the location and duties of their emergency stations immediately upon reporting aboard.</li> <li>3. Each crewmember shall be provided with an individual supplementary station bill card, which must show in detail the specific duties to perform.</li> <li>4. Entire crew shall be instructed in the performance of their specific duties and crew on watch will remain on watch until properly relieved.</li> <li>5. Emergency signals shall be supplemented with specific directions given on the public address system.</li> </ol>	
<b>Fire and Damage Control:</b> <ol style="list-style-type: none"> <li>1. Emergency squads will assemble at designated areas with their personal protective equipment to respond to fire or damage control.</li> <li>2. Person discovering FIRE shall immediately notify the bridge by sounding the nearest alarm and fight the fire with available equipment.</li> <li>3. Start fire pumps. Close all watertight doors, fire doors, ports and air vents. Stop all fans and blowers. Secure Air Conditioning Plant. Start the emergency generator.</li> </ol>	
<b>Sea and Anchor Detail/Battle Stations/CBRN Stations:</b> <ol style="list-style-type: none"> <li>1. Entire crew will report to their designated stations.</li> <li>2. Each station will notify the bridge when manned and ready.</li> <li>3. When Battle Stations are set, the entire crew will report to their stations with assigned weapon and CBRN individual protective equipment on hand and at Mission Oriented Protective Posture (MOPP) Level 0 unless otherwise specified in the announcement.</li> <li>4. MOPP Levels will increase / decrease by direction of the Vessel Master through the announcement system.</li> </ol>	
<b>Man Overboard:</b> <ol style="list-style-type: none"> <li>1. Hail, and pass the word, "MAN OVERBOARD", to the bridge. Throw life rings in water.</li> <li>2. Establish personnel accountability.</li> <li>3. Post lookouts. Maneuver vessel to recover person. Prepare to launch rescue boat. Hoist Oscar flag.</li> </ol>	
<b>Abandon Ship:</b> <ol style="list-style-type: none"> <li>1. All persons shall don their life preserver or exposure suit as directed.</li> <li>2. Establish personnel accountability.</li> </ol>	

**Table 1-2. Station bill instructions (continued)**

Collision:

1. Close all watertight hatches and standby for violent vessel maneuvering.
2. Prepare to perform damage control duties or abandon ship.

## **MANEUVERING CHARACTERISTICS**

1-62. The information on maneuvering characteristics are normally available in the following three documents:

### **Pilot Card**

1-63. This card provides in brief form, the current conditions of the ship with regard to its propulsion and steering equipment and loading conditions of the ship. The pilot card should be filled out by the ship's Master prior to the arrival of the pilot. A standardized format for the pilot card will benefit all parties involved and can prevent omission of important information when briefing the pilot.

### **Wheelhouse Poster**

1-64. The wheelhouse poster provides more complete information concerning ship hull and engine characteristics than the pilot card. It also contains information on stopping distances and trajectories for entering turns at the maximum rudder angle in loaded and ballasted conditions. Use of these standardized wheelhouse posters is helpful in presenting the required information in a form that is readily recognizable by operating personnel and pilots unfamiliar with the vessel.

### **Maneuvering Booklet**

1-65. A maneuvering booklet may also be developed to provide detailed information about the ship's maneuvering characteristics in different conditions.

## **LOAD LINE CERTIFICATION**

1-66. In general, most commercial U.S. vessels more than 79 feet (24 m) in length must have a valid load line certificate when venturing outside the U.S. Boundary Line, whether on a domestic or international voyage (even on "voyages to nowhere" that return to the same domestic port of departure). As per AR 56-9, Army vessels will maintain load line certificates. This requirement cannot be waived by any service or component.

1-67. Load line requirements, set forth in Title 46 CFR, Part 42, subpart 42.07-1, are the basis for locating load line marks on a vessel. These marks, affixed to the vessel amidships, indicate the maximum drafts to which the vessel can be legally loaded under prescribed conditions. The distance measured vertically at the side of a vessel from the edge of the so-called "freeboard deck" to the upper edge of a particular load line mark is called "statutory freeboard" -- the "minimum statutory freeboard" measured to the uppermost load line mark applicable for a specified set of conditions taking into account considerations of 1) reserve buoyancy (buoyancy which can be supplied by the hull and watertight superstructure above the water line) and height of weather deck above this water line, 2) subdivision, and 3) hull strength. In the United States, the American Bureau of Shipping is the load line assigning authority on behalf of the U.S. Coast Guard.

1-68. Load lines information is given in the vessel's "Load Lines Certificate." This document certifies to the correctness of the load line marks and that the vessel is in compliance with all applicable requirements. It also provides a diagram of the assigned load line marks and the freeboard deck line, locating the marks with reference to this line in terms of assigned freeboard, as well as stating any conditions, restrictions and exemptions that the vessel shall observe. The validity of these certificates is reviewed annually in load line inspections and every five years in more thorough load line surveys. Annual Load-line Certificate inspections not conducted can cause the certification to be suspended or revoked. During these inspections and surveys, the American Bureau of Shipping is particularly concerned with the following items:



- Freeing ports. Drainage must be adequate from every weather deck area and not blocked. Particular attention is given to potential water-trapping areas such as wells formed by structure or pockets formed by cargo or equipment.
- Sill heights. Access openings in superstructure and deck houses must have 15 - inch sills. A reduction of one inch in sill height is allowed for each foot of excess freeboard with a minimum height of 6 inches.
- Vent and hatch coaming heights and fittings above the assigned freeboard deck are carefully checked.
- Watertight doors and fittings. Any penetration of watertight boundaries must be as high and as far inboard as possible. As a minimum, three dogs are required on a circular fitting and four on an oblong fitting.
- Subdivision in general. Subdivision requirements must be met as applicable for vessels being inspected / surveyed. These requirements are the same as for those passenger vessels carrying 400 or fewer passengers and include provisions for a collision bulkhead.
- A load line map showing zones and seasonal areas of the world's oceans provides the Master with information regarding the maximum draft amidships to which his vessel can be loaded during various segments of a cruise. The vessel must be loaded at the beginning of a cruise so that at no time during the cruise will, the applicable seasonal/zone mark, be submerged.

1-69. Freeboard is vitally important on smaller vessels, which are not subject to load line requirements. Consequently, these vessels should carry information on board regarding maximum drafts amidships to which they can be loaded safely.

## TRAINING

1-70. Marine Safety training is provided to Army mariners during the Warrant Officer Basic Course (WOBC), Marine Deck/Marine Engineering Warrant Officer 880A/881A Certification Course (MDO/MEO), in subject areas of Army accident reporting, risk management, Rules and Regulations, General Shipboard Safety, and Safety Survey Procedures.

## WATERCRAFT RISK MANAGEMENT

1-71. Leaders must develop techniques that will conserve and preserve resources. Because the Army operates worldwide, missions have become increasingly demanding and so have the risks inherent in those missions. Risk management identifies risks associated with a particular operation and weighs those risks against the overall mission value to be gained. Refer to ATP 5-19, *Risk Management*. DA Pam 385-30, *Risk Management* further defines application of risk management matrices to manage risk. Document risk management DD Form 2977 (*Deliberate Risk Assessment Worksheet*). See table 1-3 on page 1-18 for the risk assessment matrix.

1-72. Risk is the probability and severity of loss linked to hazards. See table 1-4 on page 1-18 for hazard probability and severity categories. The loss can be death, injury, property damage, or mission failure. Risk management identifies risks associated with a particular operation and weighs those risks against the overall mission value to be gained. The four principles of risk management are:

- Integrate risk management into all phases of missions and operations.
- Make risk decisions at the appropriate level.
- Accept no unnecessary risk.
- Apply risk management cyclically and continuously.

1-73. Risk management process:

- Identify hazards.
- Assess the risk of those hazards.
- Develop controls and make risk decisions.
- Implement controls.
- Supervise and evaluate.

**Table 1-3. Risk assessment matrix**

		<b>Probability (expected frequency)</b>				
Severity consequence)	(expected	Frequent	Likely	Occasional	Seldom	Unlikely
		A	B	C	D	E
Catastrophic	I	EH	EH	H	H	M
Critical	II	EH	H	H	M	L
Marginal	III	H	M	M	L	L
Negligible	IV	M	L	L	L	L
<b>Legend:</b> EH – Extremely High Risk H – High risk		M – Medium Risk L – Low Risk				

**Table 1-4. Hazard probability and severity categories**

<b>Hazard Probability Categories</b>		
<b>Description</b>	<b>Category</b>	<b>Outcome</b>
Frequent	A	Likely to occur frequently
Likely	B	Will occur several times in the life of an item
Occasional	C	Likely to occur sometime in the life of an item
Seldom	D	Unlikely, but possible to occur in the life of an item
Unlikely	E	So unlikely, it can be assumed occurrence may not be experienced
<b>Hazard Severity Categories</b>		
<b>Description</b>	<b>Category</b>	<b>Outcome</b>
Catastrophic	I	Death or system loss
Critical	II	Severe injury, severe occupational illness, or major system damage
Marginal	III	Minor injury, minor occupational illness, or minor system damage
Negligible	IV	Less than minor injury, occupational illness or damage

## Chapter 2

# Lifesaving Equipment

This chapter contains information that is common to all types of personal flotation devices (PFDs). It covers recommended use, required inspections, maintenance, and modifications for each type of PFD.

### PERSONAL FLOTATION DEVICES

2-1. This section provides information on personal flotation devices which includes the different types, number required to be on hand as well as maintenance, inspection, and testing requirements.

2-2. The USCG has made recent changes to the codes used to identify the different types of personal flotation devices that are used aboard Army watercraft. The new USCG Type Code Series numbers will be listed in conjunction with the previous type codes to provide a cross reference. The new USCG series number will be listed first followed by the old type code in parenthesis. For example the Type I Life Preserver will now be listed as USCG Series 160.155 (Type I) Life Preserver.

### USCG SERIES 160.155 (TYPE I) LIFE PRESERVERS

2-3. The USCG Series 160.155 (Type I) PFD is the primary PFD used by Army personnel aboard watercraft when mobility is not a factor. Its use by personnel aboard Army watercraft is mandatory during such procedures as abandon ship (except in extremes of cold when immersion suits are required). It is also mandatory for personnel on exterior weather decks and during towing operations during heavy weather. An important feature of this PFD is its ability to hold the head of an unconscious person face up (except when worn with hypothermia protective garments like anti-exposure coveralls).

#### WARNING:

**Personnel who fall into the water from a great height may be initially stunned or injured. The USCG Series 160.155 (Type I) preserver is important where risk of neck injury is present.**

2-4. This PFD allows a person to relax completely, extending survival time and allowing the person to assume a position to protect the body from hypothermia. The main disadvantages of this PFD are its bulk (which restricts freedom of movement) and its minimum inherent buoyancy (about 22 pounds) which hampers egress from a capsized boat or swimming under water to avoid burning oil.

2-5. Personnel should wear PFDs aboard Army watercraft when risk of an individual falling overboard exists. When assessing risk, the commanding officer or master/coxswain should consider factors such as vessel size, time required to recover a person overboard, water and air temperature, sea and weather conditions, and the degree of mobility necessary for personnel to complete a task. Table 2-1 on page 2-2 describes the types of PFDs and their maximum buoyancy.

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*Note.* The USCG Series 160.155 (Type I) is the primary PFD for abandon ship procedures.

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2-6. The nonreversible vest style USCG Series 160.155 (Type I) PFD is designed for comfort and performance. A pass-thru slot in the rear panel allows the user to wear a safety harness beneath the life jacket

and secure with a tether. Features soft, comfortable Aqua-foam flotation and provides a minimum of 22 lbs. of buoyancy.

2-7. The USCG Series 160.155 (Type I) Life Preserver can be used with a safety harness if required. The use of the harness and PFD may be of benefit to personnel working over the side from a great height or personnel working topside during heavy weather. The user will properly don a safety harness inserting the “D-ring” in the pass-thru slot in the rear panel provided in the life jacket.

**Table 2-1. Types of U.S. Coast Guard (USCG) personal floatation devices (PFDs)**

<b><i>U.S. Coast Guard (USCG) Series (Previous Type Code) PFD</i></b>	<b><i>Minimum adult buoyancy in pounds</i></b>
USCG 160.155 (Type I)	22.0
USCG 160.002 (Type I Kapok)	22.0
USCG 160.176 (Type I Inflatable)	22.0
USCG 160.177 (Type I Inflatable)	22.0
USCG 160.005 (Type I Fibrous Glass)	22.0
USCG 160.052 (Type II)	33.0
USCG 160.064 (Type III Recreational Vest)	15.5
USCG 160.053 (Type III/V (Work Vest & Anti-Exposure Coveralls)	17.5 (Work Vest)
USCG 160.150 (Type IV safety of life at sea (SOLAS) Ring Buoy)	32.0
USCG 160.171 (Type V Immersion Suit-Adult)	22.0

## NUMBER REQUIRED

2-8. All watercraft will carry a standard USCG 160.155 (Type I) life preserver for each authorized person on board. An additional number shall be provided for personnel on watch in the engine room, pilothouse, and for the bow lookout. Watercraft with living/working spaces forward, separated from messing or recreational spaces, shall stow additional life preservers for 50 percent of the total number of crew members on board in those spaces. It is the responsibility of the commands being supported, not the vessel or their command, to provide life preservers for any passengers who embark on board Army watercraft other than those vessels specifically designed and equipped for passenger-carrying. More compact, easily storable USCG 160.155 (Type I) Life preservers may be carried for passenger use, in lieu of the more bulky deluxe model.

2-9. Additionally, class “A” watercraft will carry one immersion suit for each assigned crew member on board, plus an additional immersion suit for each underway watch station (such as bridge, lookout, and engine room).

2-10. Make the following modifications before placing the PFDs into service.

- All PFDs placed into service will have a whistle, one distress signal light, and reflective tape/material secured to the vest.
- Check whistle and distress signal light for proper operation. (If distress light is the chemical type, DO NOT activate until required).
- Mark the vest with the vessel’s name or hull number.

## MAINTENANCE, INSPECTION AND TEST REQUIREMENTS

2-11. Complete the following inspections and tests as required:

### Quarterly Inspection.

- Inspect the PFD for tears, rips, and missing webbing, tapes, and hardware.
- Inspect and test the whistles and distress signal lights. (DO NOT activate chemical light. Check for expiration date).

- Inspect the reflective tape/material for cracking, peeling, and discoloration.
- Replace as necessary.

### **Semiannual Inspection.**

- Complete all quarterly inspection steps as described above.
- Tug sharply on all straps and ties to check for rotted fabric or broken stitching.
- If any of the above does not meet standard, replace the vest.

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**Note.** Before placing the PFDs into service, perform and record in the logbook a semi-annual inspection as described in above paragraph.

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## **STOWAGE**

2-12. PFDs should be stored in a dry place out of direct sunlight. Heat, moisture, and light contribute to the deterioration of the PFD. Duplicate PFDs are required for persons whose normal workstation is not near their berthing area. Immersion suits are intended for “abandon ship” use. Stow them so they are readily accessible to the individuals for whom they are intended with container handles exposed, or according to manufacturer’s directions. This is to prevent searching throughout the vessel to find them in an emergency. Ensure suit is dry and clean. Stack suits IAW manufacture guidance. Excessive stacking can compress suits at the bottom of the pile, eventually damaging the buoyant insulating foam. Keep all PFDs away from oil, paint, and greasy substances. **DO NOT STOW ANY PFDs INSIDE A LOCKED CONTAINER.**

2-13. PFDs are equipped with reflective tape/material when they are manufactured. The material is positioned on the suit to make a person wearing the suit in the water as visible as possible under nighttime search conditions. The pattern is not necessarily the same as that used on a lifejacket or other PFDs. Remove and replace unserviceable reflective tape/material by cutting two 2 X 4-inch pieces of reflective tape/material and applying it to the PFD.

## **DONNING AND ADJUSTING**

2-14. The USCG 160.155 (Type I) Life Preserver must be worn properly in order for it to function correctly. Refer to the manufacture instructions to ensure the USCG 160.155 (Type I) Life Preserver is donned correctly and adjusted to fit the individual. Improper wear of the USCG 160.155 (Type I) Life Preserver may cause injury or cause it to lose its buoyancy.

## **USCG SERIES 160.053**

2-15. The lightweight USCG 160.053 (Type III/V) PFD includes soft comfortable closed cell foam inside a heavy-duty shell and encircling body belt with snag resistant buckle for quick adjustment. The hinged back panel and mesh lining for ventilation gives maximum comfort in a work vest. This vest also includes a flotation collar for added protection and 62 sq. in. of reflective tape. This design allows the PFD to conform more closely to the shape of the body. Because this vest-type PFD is light in weight, the wearer can work in comparative comfort.

2-16. The USCG 160.053 (Type III/V) PFD provides less flotation than the USCG 160.155 (Type I). They will not hold the head of an unconscious person face up to ensure survival. Their use may be appropriate when greater freedom of movement is needed and the risk of falling into the water from a great height does not exist. People on floats consider them acceptable for use if safety rails are in use and over the side on stages or boatswain’s chairs if the person is secured by a tended safety line. These PFDs may be used aboard Army watercraft in calm weather and in calm water. Their main disadvantages are limited flotation, the tendency to ride up on the wearer, minimum buoyancy (17.5 pounds), and requires conscious effort to keep the wearer’s head out of the water.

**WARNING**

The work-type PFD is buoyant enough to keep the wearer afloat in calm conditions. It has no self-righting capability and will not keep an unconscious wearer's head out of the water while awaiting rescue. This PFD is to be worn when the water temperature exceeds 60° F.

**Donning and Adjusting**

2-17. The USCG 160.053 (Type III/V) PFD must be worn properly in order for it to function correctly. Refer to the manufacture instructions to ensure the USCG 160.053 (Type III/V) PFD is donned correctly and adjusted to fit the individual. Improper wear of the USCG 160.053 (Type III/V) PFD may result in injury or cause it to not perform properly.

**HYPOTHERMIA PROTECTIVE CLOTHING**

2-18. This section contains information about hypothermia protective clothing designed to permit personnel to function and survive in cold water. Table 2-2 describes how hypothermia affects most adults.

**Table 2-2. Hypothermia effects**

<i>Water temperature in degrees F</i>	<i>Exhaustion or unconsciousness</i>	<i>Expected time of survival</i>
32.5	Under 15 minutes	Under 15 to 45 minutes
32.5 to 40	15 to 30 minutes	30 to 90 minutes
40 to 50	30 to 60 minutes	1 to 3 hours
50 to 60	1 to 2 hours	1 to 6 hours
60 to 70	2 to 7 hours	2 to 40 hours
70 to 80	2 to 12 hours	3 hours to indefinite
Over 80	Indefinite	Indefinite

**WARNING**

The immersion suit provides the best protection from hypothermia in the water. However, it is extremely bulky and awkward to work in and is therefore limited to use for crews operating in cold weather when abandoning ship.

The anti-exposure coverall provides good durability and out-of-water protection from the elements. It provides limited protection from hypothermia to crewmembers in the water.

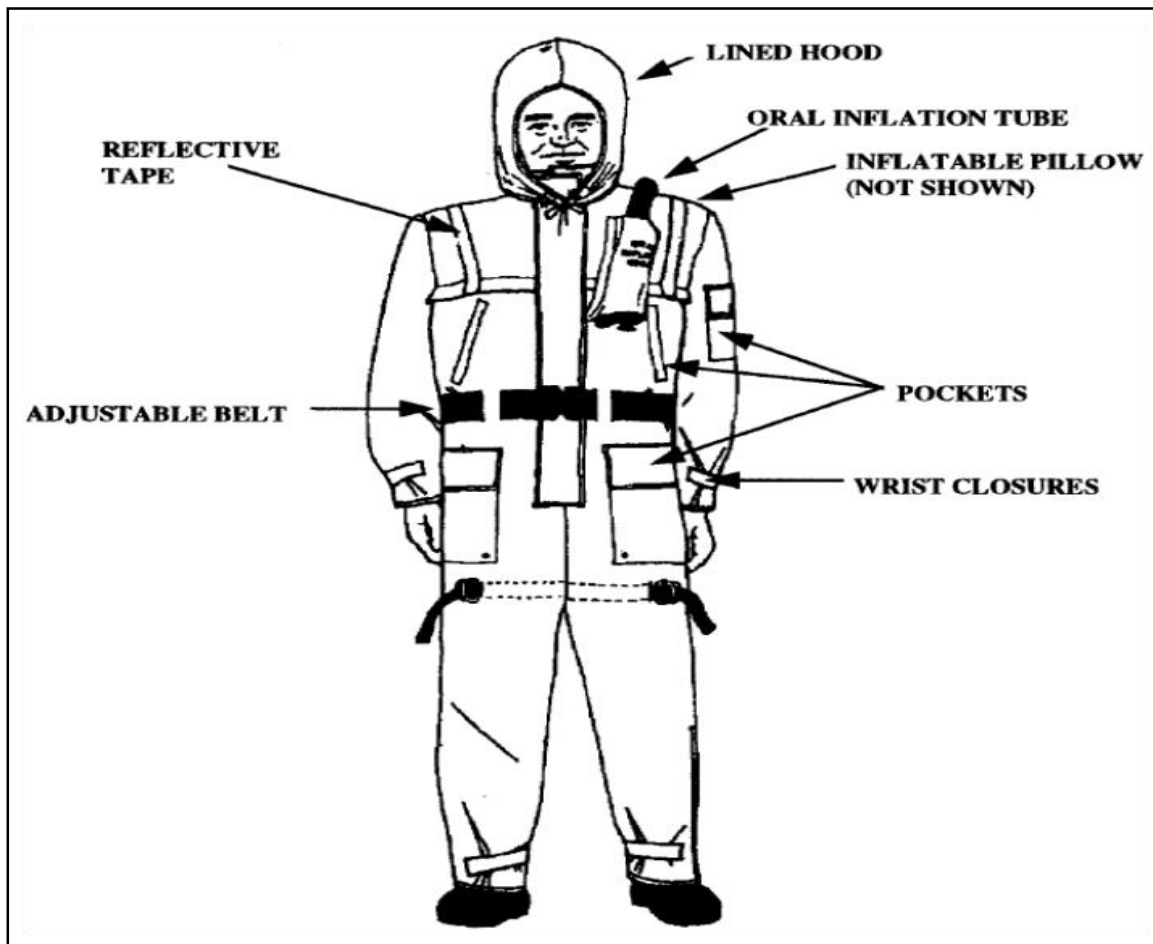
## **APPLICATION**

2-19. Commanders and vessel masters will ensure compliance with the following guidelines on hypothermia protective clothing:

- Watercraft crewmembers shall wear hypothermia protective clothing if the water temperature is below 15.6 degree Celsius (60 degrees Fahrenheit).
- The commander or vessel master may waive the requirement for wearing an anti-exposure coverall if the degree of risk to hypothermia is small (such as in non-hazardous daylight rescue operations in calm water).
- A PFD should NOT be worn over an anti-exposure coverall or survival suit because the device is inherently buoyant. Although a PFD will improve chances for survival during prolonged periods because it provides improved flotation, the additional buoyancy creates problems for the wearer attempting to leave capsized watercraft.

## **USCG 160.053 (TYPE III) ANTI-EXPOSURE COVERALL**

2-20. Personnel operating in a cold, wet environment will wear the anti-exposure coverall (see figure 2-1 on page 2-6) when they need protection from hypothermia or when operating in an area where the water temperature is less than 59 degree F. The anti-exposure coverall (often called a deck suit or work suit) affords adequate protection from exposure to cold water, wind, and spray. It provides flotation similar to that provided by the work vest.



**Figure 2-1. USCG 160.053 (Type III) Anti-exposure coverall**

2-21. The main advantage of the USCG 160.053 (Type III) PFD is its wearability, ease of donning, simple construction, and neat appearance. The disadvantages are limited flotation (no righting moment) and minimum buoyancy (about 16 pounds). Wear this PFD only when you require greater freedom of movement and the mission and environment are less hostile.

2-22. Anti-Exposure Coverall, USCG 160.053 (Type III) PFD is not universally sized. Two or three different sizes are required to fit adults properly.

2-23. USCG 160.053 (Type III) PFD may be used as a substitute for the work-type preserver.

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**Note.** The anti-exposure coverall is primarily used by watercraft crewmembers where they may be exposed to intermittent spray.

---

2-24. The anti-exposure coverall is made of orange urethane-coated nylon exterior fabric with a closed-cell foam interlining to provide thermal protection. It provides at least 17 ½ pounds of buoyancy. The coverall allows full freedom of movement. The suit features an attached, orally inflated pillow to support the wearer's head in the water. It also has an attached hood for extra thermal protection and reflective tape/material on the hood and shoulders for better visibility at night. For added protection, personnel should carry waterproof gloves for use with the anti-exposure coverall. The coverall is manufactured in five sizes ranging from small to extra-large.

2-25. Don anti-exposure coverall in the same fashion as standard coverall.



## CLEANING

2-26. To clean the anti-exposure coverall, follow the manufacture cleaning instructions on the label. When coveralls have been submerged or exposed to salt water or salt spray, wash them in a shower with a mild soap. Machine washing can damage the suit and is NOT recommended.

### CAUTION

Do NOT attempt to dry anti-exposure coverall in a clothes dryer. Do NOT wring out anti-exposure coverall. To dry coverall, hang on a wooden hanger in a cool, dry, well-ventilated area. Do not dry in direct sunlight.

### CAUTION

Do not use thinners, solvents, or similar agents for cleaning coverall that have been exposed to paint, paint removers, acids, solvents, gasoline, or any substance containing acetones.

## INSPECTION AND MAINTENANCE

2-27. Units shall inspect the anti-exposure coverall quarterly. To inspect the coverall, proceed as follows:

- Lubricate the zipper.
- Lay out suit and check for obvious damage.
- Work entry zipper up and down to check for ease of operation. Rubbing a bar of soap or paraffin (NO oil or grease) over edges of zipper will ease operation.
- Check buoyancy chamber and inflation tube for obvious damage.
- Inflate buoyancy chamber and check for leaks.
- Deflate chamber and stow in chamber casing.

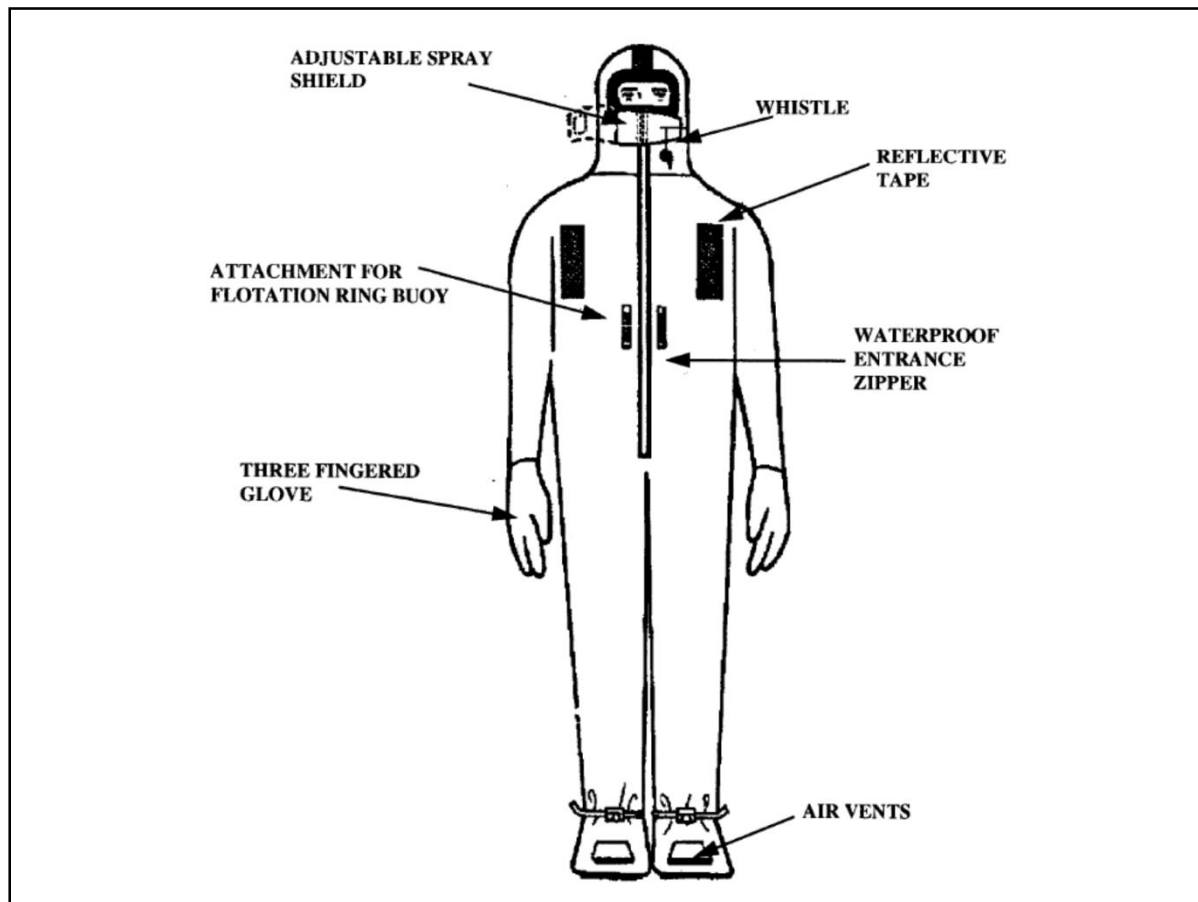
## REPAIRS

2-28. Units should make only minor sewing repairs to anti-exposure coverall. Obtain commercial assistance for repairs beyond the capabilities of the unit.

## USCG SERIES 160.171 (TYPE V) IMMERSION SUIT

2-29. The USCG 160.171 (Type V) immersion suit is worn by crews when abandoning ship. The suit affords protection from exposure to cold water, wind, and spray. The foam fabric is a durable and elastic material with high flotation characteristics providing approximately 35 pounds of buoyancy.

2-30. The approved immersion suit (shown in figure 2-2 on page 2-8) is a one-piece, international orange garment constructed from 3/16-inch nylon-lined neoprene or polyvinyl chloride (PVC) foam.



**Figure 2-2. USCG 160.171 (Type V) Immersion suit (typical)**

*Note.* The buoyancy provided to the lower torso will cause the wearer to float horizontally either face up or face down in rough seas. Additional flotation, such as the inflatable collar provided with the suit, must be used to assure face up flotation. The Adult Universal immersion suit is designed so that one size will fit most persons (weighing between 110 and 330 pounds). Other sizes are available. The thermal qualities of the fabric/foam laminate will keep personnel warm whether they are wet or dry. The immersion suit has a ten year life span and must be safety of life at sea (SOLAS) approved.

2-31. Masters and coxswains of watercraft that have immersion suits will ensure that every other abandon ship drill conducted uses the immersion suits in lieu of the life vest.

2-32. Attach a personal distress signal light to the left breast pocket.

2-33. To don the immersion suit, proceed as follows:

- Remove suit from stowage bag with a sharp jerk of the carrying bag.
- Don suit in the same fashion as donning coverall.
- Insert the non-dominate arm first, then don the hood, then insert the dominate arm.
- Close the zipper completely. To avoid problems zipping up the suit, arch your back to remove wrinkles in the fabric.
- Close the spray shield and inflate the collar for additional flotation.

### CAUTION

When donning/wearing the immersion suit, extreme caution shall be taken to avoid sharp, protruding objects that may snag or tear the suit.

## CLEANING

2-34. To clean the immersion suit, complete the following steps:

- When suits have been submerged or exposed to salt water spray, suits shall be washed under a shower with a mild soap.
- Do NOT wring out immersion suits.
- To dry the suit, hang it on a wooden hanger in a cool, dry, well-ventilated area.
- Do NOT dry in direct sunlight.

### CAUTION

In NO situation shall thinners, solvents, or any similar agents be used to clean suits that have been exposed to paint, paint removers, acids, solvents, gasoline, or any substance containing acetones.

## INSPECTION AND MAINTENANCE

2-35. The immersion suit shall be inspected before being placed into service and quarterly thereafter. To inspect the suit, proceed as follows:

- Stowage bag - Check condition of snaps on bag for ease of operation.
- Suit - Lay out on a flat, clean surface and check for obvious damage.
- Zipper - Work zipper up and down to check for ease of operation. If zipper is excessively rough, wipe with a soft, clean, lint-free cloth and lubricate with the wax lubricant found in suit breast pocket.

---

**Note.** The teeth that actually secure the waterproof zipper are the small teeth on the inside of the zipper. A little corrosion on these teeth can block the slider or damage the teeth so the zipper does not operate. If a closed zipper can be separated when probed with a (dull) knife, the zipper needs to be replaced.

---

- Inflatable collar - Check collar for obvious damage.

---

**Note.** Periodically inflate and allow it to stand overnight. If the collar does not stay firmly inflated overnight, it should be repaired or replaced. Inspect lock screw on inflatable collar inflation tube to ensure that it is in the unlocked position.

---

## PACKING

2-36. To repack the survival suit after inspection, follow the manufacturer's instructions or proceed as follows:

- Lay out suit on a flat clean surface with front up and arms out.
- Make sure entry zipper is in the open position.
- Roll or fold suit, feet first, up to chin, making sure not to wrinkle water valves.
- Fold arms horizontally across roll.

- Place suit in bag and close snaps.
- Stow bag with handle exposed.

### REPAIRS

2-37. Crew members are only authorized to make emergency repairs to the immersion suit while at sea. All other repairs need to be performed by the manufacturer. All quality assurance and quality control measures on repairs will be the responsibility of the vessel master.

#### CAUTION

Repairs should be made only with neoprene (contact) cement. Other cements may contain solvents that would weaken the material.

- Separated seams, rips and tears. To repair, complete the following steps:
  - Trim jagged edges with scissors until new rubber shows.
  - Remove old cement.
  - Thoroughly dry material.
  - Apply neoprene cement IAW manufactures instructions.
  - Apply four coats of cement along entire surface of material to be repaired.
  - Allow each coat to dry between each application.
  - When the last coat becomes tacky, align edges. Apply firm and even pressure when pressing edges together. Hold edges together for 3 or 4 minutes.
  - Allow at least 1 hour for cement to set before using repaired item.
- Holes. To repair holes, complete the following steps
  - When entire areas are missing, trim edges of area to convenient configuration.
  - Cut a replacement piece conforming to size and shape of prepared area.
  - Proceed as in steps shown in repairing separated seams above.
- Corroded zippers. To clean zippers, complete the following steps:
  - Scrub with toothbrush, using fresh water
  - Rub Bees Wax over edges of zipper to act as a lubricant and retard corrosion. The use of other substances may cause the zipper to malfunction

### PERSONNEL MARKER LIGHT

2-38. The personnel marker light (PML) is a chemical light developed for use on PFDs and hypothermia protective garments (immersion suit). It is used to attract the attention of search and rescue aircraft, ships, or ground parties. Once activated it provides light for approximately 8 hours. The PML is equipped with a pin-type clip and should be attached to the PFD front left shoulder. See figure 2-3 on page 2-11 for an example of a PML.

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**Note.** The PML is the only chemical light authorized for use and is intended to replace one-cell flashlights as they go out of service.

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### OPERATING INSTRUCTIONS

2-39. To activate the PML firmly squeeze lever against light tube, breaking sealing band and ampoules inside light. Slide protective sleeve from PML.

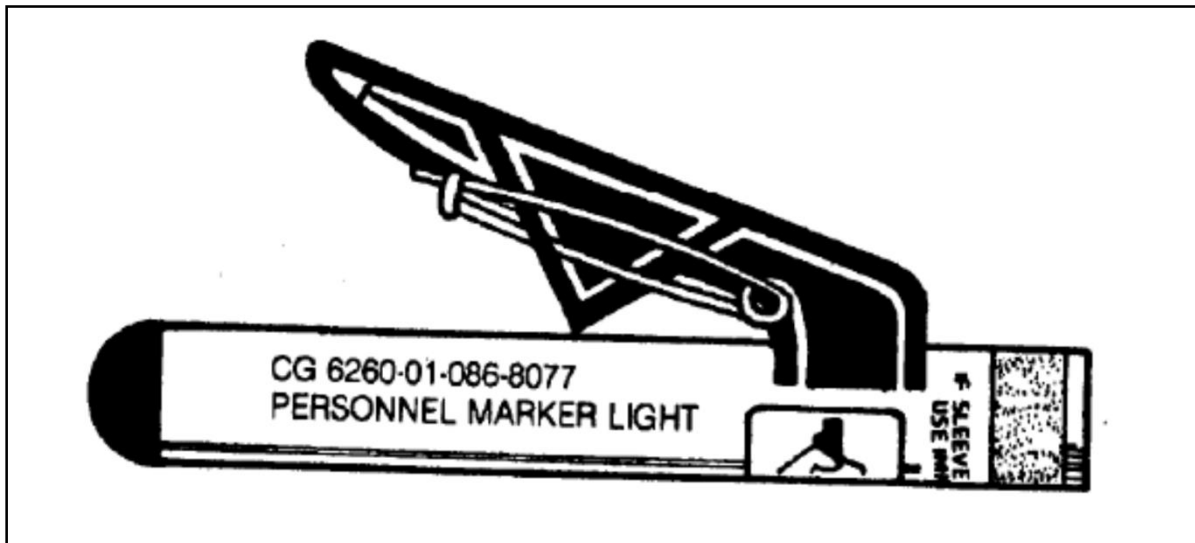


Figure 2-3. Personal marker light

## INSPECTION

2-40. Personnel marker lights placed into service shall be inspected during normal inspection cycles of equipment, such as PFDs and hypothermia protective garment, to which it is attached. Do the following to inspect the PML:

- Inspect sealing band on protective sleeve for security.
- Check expiration date stamped on sealing band. Replace PML prior to manufacturer's expiration date.
- Examine safety-pin-type clip for deformity. If pin is deformed, replace the PML.
- Ensure safety pin is in the closed position.
- Discard expended or out of date PML IAW unit HAZMAT / Environmental standing operating procedure (SOP).

---

**Note.** Protective sleeve must be kept in place to protect against accidentally breaking the glass ampoule and to protect against deterioration of chemical by ultraviolet light.

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## MAN OVER BOARD INDICATOR

2-41. In the event of a man overboard situation the man-overboard-indicator (MOBI) transmitters self-activate within 3-to-5 seconds of submersion in either fresh- or saltwater and immediately transmit the user's location and relative bearing to all MOBI systems within range. The MOBI system also provides the name of the individual who has fallen, as well as the name of the ship from which he fell and the Global Positioning System (GPS) coordinates of the location of the man overboard incident. The transmitter emits a flashing strobe to provide improved visibility of survivors in the water.

2-42. The MOBI signal can be tracked by any Search and Rescue (SAR) assets utilizing radio direction finders, and provides continuous relative bearing to a user's location. While the transmitter's trackable distance depends on ships' antenna height and weather conditions, U.S. Navy experience has documented an effective range of up to 18 nautical miles (nm) from ship to survivor. Air assets are able to track survivors over distances greater than 60 nautical miles, aiding in swift and life-saving recovery efforts.

2-43. On vessel equipped with the MOBI, there are four parts to the system (see figure 2-4 on page 2-12).

2-44. Transmitter. On deck, personnel are equipped with a matchbox-sized, serialized TRANSMITTER (1 in figure 2-4) unit. In an overboard emergency, 3-5 seconds of saltwater immersion automatically activates the unit, sending out a very high frequency (VHF) signal via the flexible antenna.

2-45. Receiver. The transmitter's VHF signal triggers an audible alarm on the bridge-mounted RECEIVER (2 in figure 2-4) within a normal surface-to-surface range of 1-2 nautical miles. The liquid crystal display (LCD) immediately shows the person's identification information.

2-46. Radio Direction Finder Antenna. The RADIO DIRECTION FINDER ANTENNA (3 in figure 2-4) locates the transmitter's VHF signal within a normal surface-to-surface range of 1-2 nautical miles. Transmitters can be tracked up to 18 nautical miles, depending on antenna height and weather conditions. Relative bearing information is displayed on the bridge-mounted radio direction finder.

2-47. Radio Direction Finder. The RADIO DIRECTION FINDER (4 in figure 2-4) is a bridge mounted unit that allows immediate and coordinated rescue to be directed from the ship. A portable unit is installed on the ship's rescue life raft and speeds SAR directly to the victim.

2-48. MOBI Transmitters are issued to individuals upon assignment to a vessel. Adjust vessel information as required for changes to vessel assignment.

### CAUTION

To ensure that the MOBI device will properly function, care must be given to how the device is worn. See the vessel SOP and manufactures instructions for more information.

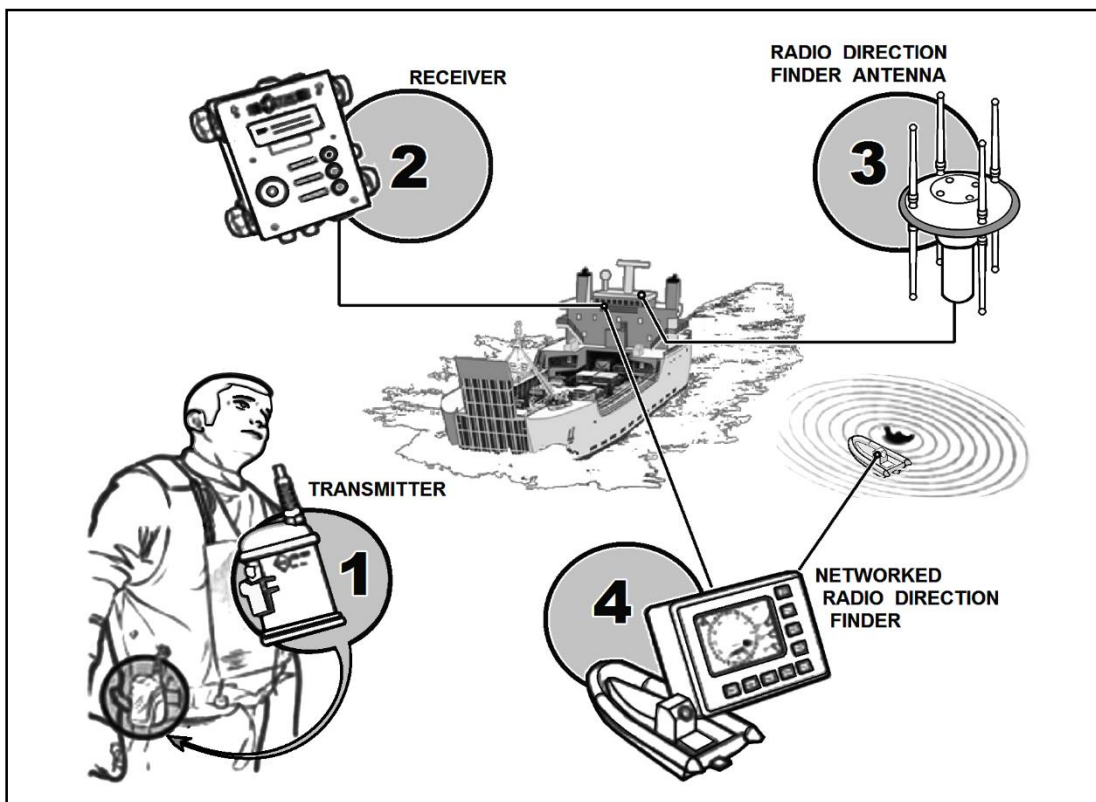


Figure 2-4. Man overboard indicator (MOBI)

## SIGNAL WHISTLE

2-49. The signal whistle emits an audible signal to rescue ships or personnel. One whistle shall be attached to each PFD and to each hypothermia protective garment.

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*Note.* Life jacket, work vest, anti-exposure coverall, & immersion suits includes an attached whistle.

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## CONFIGURATION

2-50. The signal whistle is made of plastic with a lanyard attached for easy access and to prevent loss. Whistles may be of the ball type or multi-tone (pea-less) type.

## APPLICATION

2-51. The signal whistle is used to attract attention of rescue ships or personnel in foggy weather or at night. Whistle range is 1,000 yards.

## INSPECTION

2-52. Signal whistles shall be inspected during the normal inspection cycle of the equipment (such as the PFD or hypothermia protective garment) to which it is attached. Do the following to inspect the signal whistle:

- Ensure side discs of the ball type whistle are neither loose nor missing. Check both types of whistles for cracks and damage. Replace damaged or defective whistles.
- Blow whistle normally (regular exhalation), then with forced exhalation. Replace the whistle if it fails to emit a highly audible sound.

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*Note.* The signal whistle must be tethered to the PFD or hypothermia protective garment.

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## RING BUOY

2-53. The standard ring buoy (figure 2-5 on page 2-14) is a 30-inch diameter, inherently buoyant, plastic buoy. Ring buoys are intended to be used when a person falls overboard. A ring buoy with a floating distress marker attached shall be readily available on each side of the watercraft. Other life ring buoys must be at least as long as twice the height where it is stowed above the waterline with the vessel in its lightest seagoing condition, or 30 meters (100 feet) in length, whichever is the greater, buoyant, non-kinking, 5/16 -inch diameter, 1124 pounds breaking strength and be of a dark color if synthetic, or of a type certified to be resistant to deterioration from ultraviolet light. All ring buoys will have SOLAS approved, reflective tape 2 inches wide attached.

2-54. Ring buoys are deployed as follows:

- When “Man Overboard” occurs, a ring buoy with distress marker is immediately thrown towards the individual in the water.
- The buoys have a two-fold purpose:
  - To mark the spot where the individual entered the water so that the area will be visible to the turning vessel
  - To give the individual some additional buoyancy to hold on to.

2-55. When the vessel is close enough to the individual, the ring buoy with the retrieving line is used. The bitter end of the retrieving line is either tied to the vessel or held by the Soldier-mariner throwing the ring buoy to the individual in the water. After the individual gains control of this ring buoy, he is drawn to the vessel’s side and hoisted on board the vessel. Reflective tape or material assists in locating the ring buoy at night.

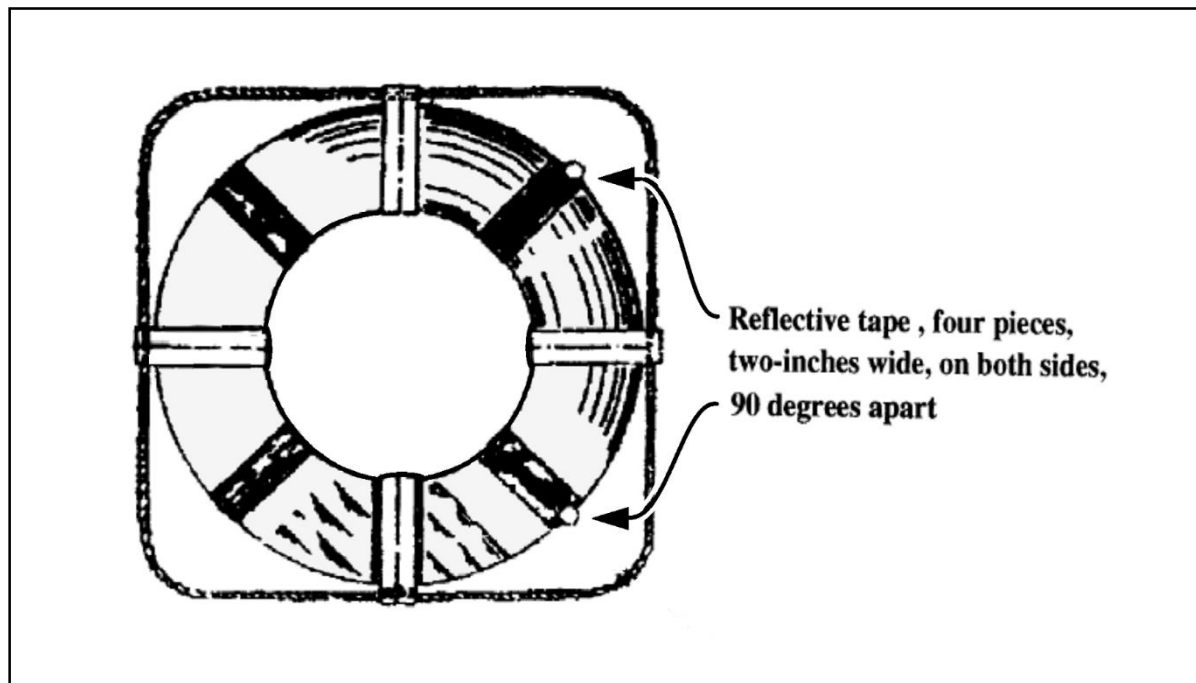


Figure 2-5. Ring buoy with reflective tape/material

## NUMBER REQUIRED

2-56. The minimum number requirements for 30-inch ring buoys and the minimum number which shall have distress markers, smoke signals, or retrieving lines, shall be in accordance with the vessels BII or unit SOP.

*Note.* Marine smoke/flame location marker will be located on the port and starboard bridge wing in the vicinity of the ring buoy with distress marker light.

## INSPECTION

2-57. Inspect ring buoys every six (6) months as follows:

- Inspect ring buoy for general condition of inherently buoyant material, such as holes, cracks, and rips.
- Inspect condition of lifeline, replace as required.
- Inspect retrieving line for condition and security. The retrieving line shall be securely attached to the ring buoy lifeline with an eye splice. Retrieving lines shall be stowed in a loose coil and lashed in place on the ring buoy with an easily breakable cotton thread.
- Inspect the reflective tape/material for tears and missing pieces.
- Ensure that the ring buoy is orange in color (international) and stenciled with the vessel's name or number and the legend "U.S. ARMY".
- If a ring buoy is found unserviceable, remove it from the watercraft immediately.

## MODIFICATIONS

2-58. Some modifications are required for ring buoys before use:

- To aid in locating a ring buoy at night, there shall be four pieces of SOLAS approved, reflective tape 2 inches wide, wrapped around each ring buoy at 90° apart as shown in figure 2-5.
- Attach 90 feet of retrieving line, using an eye splice, to each ring buoy without a distress marker or smoke signal.



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**Note.** Marine smoke/flame location marker will accompany the ring buoy with distress marker light located on the port and starboard bridge wing but will NOT be attached to either.

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- Attach a floating distress marker to each ring buoy positioned for man overboard emergency. It is attached by the halyard snap and 2 feet of 1/4-inch diameter, polyethylene line.

### **CAUTION**

To reduce possible injuries to individuals in the water due to high heat and bright light, marker should be thrown into the water immediately after ring buoy with battery operated distress marker. Distress marker will help individual locate ring buoy while Marker, Location, Marine, Smoke/Flame (MK 58 Mod 1), will help vessel locate individual.

## **DISTRESS SIGNALS**

2-59. The following section provides detailed information on the various types of distress markers and signals used aboard Army watercraft.

### **FLOATING DISTRESS MARKER**

2-60. The floating distress marker (see figure 2-6 on page 2-16) is a watertight, vapor proof, battery-operated flashing light normally used during darkness to mark the location of objects in the water. It is attached to ring buoys used at man overboard and lookout stations. The capacitor discharge xenon flashtube emits flashes of light at a rate of 60 +/- 10 flashes per minute for a minimum duration of 15 hours. The mounting bracket is designed to hold the light in an inverted position yet release it when a pull of 20 to 40 pounds is applied. External parts of the light, other than the lens, are international orange. The floating distress marker will be modified by the crew by adding reflective tape just below the light housing when the light is in the "on" position (upright) and marking the outer casing with the vessel's hull number and "U.S. Army".

### **INSPECTION AND MAINTENANCE**

2-61. The floating electric marker light shall be inspected before placing the light into service and every 6 months thereafter. Maintenance of the floating electric marker light is limited to inspection, replacement of batteries, and cleaning. To inspect the light, complete the following steps:

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**Note.** Weak batteries, internal corrosion, and lack of water tightness are major reasons for failure of floating lights.

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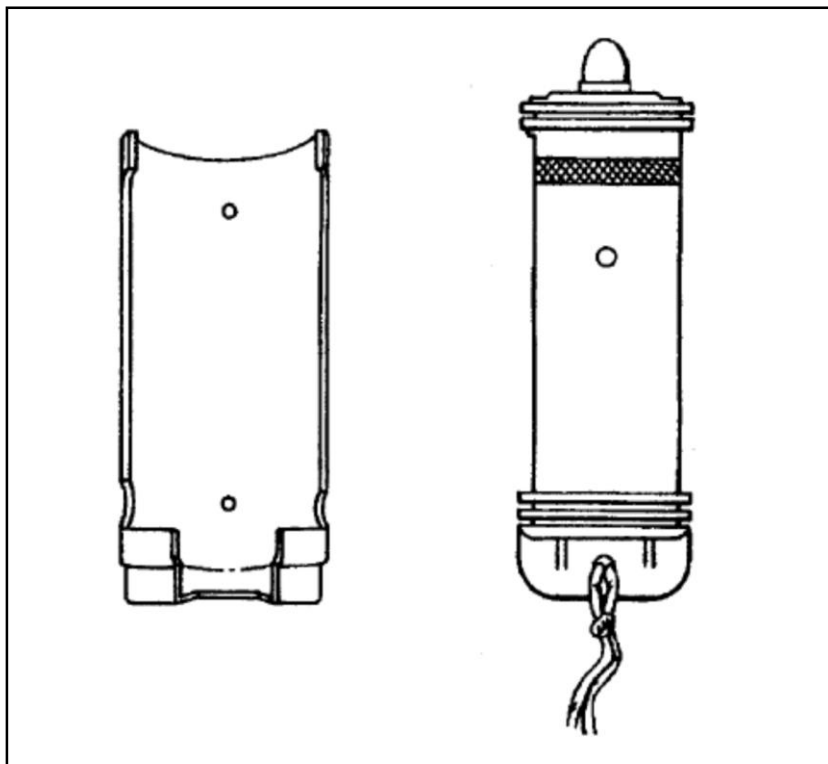
- Remove light from bracket, ensuring its easy removal.
- Remove battery from light.
- Inspect lens and case for interior condensation and cracks.
- Inspect condition and security of lanyard and halyard snap hook. Replace as necessary.
- Inspect battery compartment for corrosion or signs of battery leakage. - Clean and dry all contacts.
- Clean exterior of light using a mild soap and water solution and a soft cloth.
- Thoroughly dry exterior of light.
- Replace any cracked or broken gaskets.
- Install a new battery. Maximum battery weight is 1.49 pounds. Batteries heavier than this will cause the light to sink. Refer to manufacture instructions for exact battery types.
- Test the light by inverting it (lens up). The light should come on and flash at a rate of 60 +/- 10 flashes per minute.

- Test internal switch by turning light upside down (lens down); light should extinguish. If light does not flash or extinguish, replace light.

**CAUTION**

Do not keep the lamp in a lighted position more than necessary since operating life will be reduced.

- Mark date of inspection and replacement of battery on outside of light using stencil, marking pen, or plastic tape.
- Ensure date of inspection is documented under test, drill and inspections in the vessel's Official Deck Log Book.
- Replace light in bracket with lens down.



**Figure 2-6. Floating distress marker**

**MODIFICATIONS**

2-62. The following describes modifications to the floating electric marker light:

- Attach a 4-foot length of yellow, polyethylene/polypropylene, (1/4-inch diameter, 3 strand, 1000 pound breaking strength) line with an eye splice.
- Attach a halyard snap to the opposite end of the line using an eye splice. The halyard snap is used to attach the light to the ring buoy or other objects. To aid in locating a nonfunctional light, a 1-inch wide strip of SOLAS retroreflective tape shall be applied to the upper body of the light.
- Ensure tape totally encircles the body of the light.

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**Note.** Configuration of distress marker lights for this national stock number (NSN) may vary. Insure the correct battery is used by checking the owner's manual for correct requisitioning information; otherwise the light may not work or float upright when thrown into the water.

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## PYROTECHNIC DISTRESS SIGNAL DEVICES

2-63. This section contains information about military pyrotechnic distress signal devices authorized for U.S. Army watercraft. Headquarters, Department of the Army policy states that commercial munitions, including pyrotechnics, are NOT authorized on Army equipment nor utilized by Army personnel. The only exception is in the event that a vessel is deployed forward of its home base; SOLAS standard pyrotechnics and safety items can be procured and utilized when items within the DOD procurement system cannot be obtained. The military-issue devices have no expiration date. This chapter describes the following pyrotechnic devices:

- Signal Illumination, Ground, Red Star, Parachute, M126A1
- Marker, Location, Marine, Mk 58 Mod 1
- Signal, Smoke and Illumination, Marine, MK124 Mod 0

## PRECAUTIONS

2-64. Precautions should be taken when using, handling, and storing pyrotechnic devices. The following are warnings, precautions, and procedures for these devices:

### WARNING

**Personnel handling pyrotechnic signal flares shall comply with all existing safety requirements and precautions. Pyrotechnics are hazardous due to the nature of their explosive, flammable, or toxic filler.**

- DO NOT remove the signal device from its hermetically sealed container until immediately before use.
- Read and follow the firing instructions on the signal body.
- Handle pyrotechnic flares with the same care as high explosives.
- Protect flares and signals from moisture.
- Remove and replace flares when there is evidence of moisture.
- Disassembly of flares is strictly prohibited.
- DO NOT use flares when they are rusted, dented, or deformed. (They must be segregated for disposal).
- Avoid any rough handling, throwing, or dropping of pyrotechnics.
- DO NOT look into the firing end of any signaling device.
- Remove flares and signals from watercraft placed in storage.

## DISPOSAL

2-65. All unserviceable pyrotechnics should be turned in to the local ammunition supply point for proper disposal.

## MISFIRES

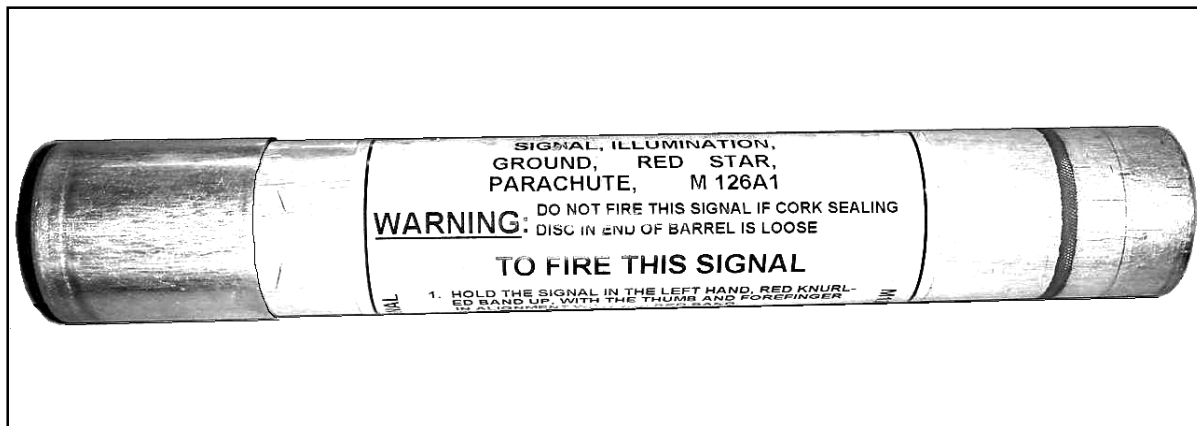
2-66. Misfired signals must NOT be approached until at least 30 minutes have elapsed after firing was attempted. All misfires and malfunctions involving these signals will be reported through the appropriate munitions supply channels.

## AUTHORIZED PYROTECHNICS ALLOCATIONS

2-67. U.S. Army watercraft are authorized certain pyrotechnics. These pyrotechnics are described in the vessels BII, DA Pamphlet 350-38, *Standards in Training*, and by unit SOP.

## SIGNAL, ILLUMINATION, GROUND, RED STAR, PARACHUTE, M126A1.

2-68. The M126A1 signal flare is a rocket-propelled, fin-stabilized, hand launched distress signal for watercraft operating in ocean or coastal waters. The signal is shown in figure 2-7.



**Figure 2-7. Signal, illumination red star parachute, M126A1**

When fired vertically, the signal projects to an altitude of 650 to 800 feet. It also produces a parachute-suspended red star that burns for approximately 50 seconds while descending at the rate of 8 feet per second.

2-69. Firing Instructions. Firing illustrations are depicted in figures 2-8 and 2-9 on page 2-19).

- Remove the signal from its container in accordance with the instructions printed on the container

### WARNING

**DO NOT FIRE A HANDHELD SIGNAL IN AN AREA WITHOUT OVERHEAD CLEARANCE. WHEN FIRED IN AN AREA WITHOUT OVERHEAD CLEARANCE, THE SIGNAL CAN CAUSE FIRE, INJURY, OR DEATH.**

- Hold the signal in the left hand, red knurled band up, with thumb and forefingers, in alignment with the red band.
- Withdraw the firing cap from the lower end of the signal
- Point the ejection end of the signal (the end opposite the red knurled band) away from the body and away from friendly personnel, equipment, and materials, and SLOWLY push the firing cap onto the primer (red band) end until the cap is aligned with the lower edge of the knurled band. DO NOT permit the cap to go beyond the lower edge of the band.
- Hold the signal FIRMLY at arm's length with the left hand in a truly vertical position, firing cap downward.

### WARNING

**Turn your head away from the signal to avoid injury to your face and eyes from particles ejected by the small rockets.**



**Figure 2-8. Firing a handheld signal flare**

- Strike the firing cap bottom sharply with the palm of the right hand keeping the left arm rigid.

### **CAUTION**

When firing handheld signals by hand, avoid contact with the bones of the hand. This can result in injury to the hand. Instead, use the meaty portion of the hand.



**Figure 2-9. Firing a handheld signal flare (continued)**

## **HANDLING AND STORAGE**

2-70. This signal shall be handled and stored in accordance with the general precautions outlined in paragraph 2-64. In addition, the following special rules apply:

- The signal must not be removed from its hermetically sealed container until immediately before it is to be used.
- No signal shall be stored or restored unless it is securely sealed in its steel container.
- In all handling, care must be taken to avoid striking the signal primer.

- Dented, cracked, or otherwise damaged signals must not be used. They shall be carefully segregated in a completely dry storage location for return to a shore station for appropriate disposal.
- If a signal misfires, it should be placed in a secure position to prevent personnel from being impacted should the signal fire. The signal must not be approached for at least 30 minutes.

### SAFETY PRECAUTIONS

2-71. In addition to the handling and storage instructions outlined in paragraph 2-70 above, the following special rules shall be strictly observed:

- DO NOT remove the signal from its hermetically sealed container until immediately before use.
- DO NOT attempt to use dented, cracked, or otherwise damaged or deteriorated signals. They must be segregated for early disposal.
- Before installing the firing cap over the primer end of the signal, be sure to avoid striking the primer.
- Read and follow the firing instructions on the signal body.
- The person firing the signal and all friendly personnel in the immediate vicinity should wear helmets to avoid injury by the falling spent rocket motor and other debris.
- When pushing the firing cap onto the primer end of the signal, be sure that the signal is not pointed toward your own body or toward friendly personnel, equipment, or materials.
- Push the firing cap SLOWLY over the primer end of the signal, being sure not to push it beyond the lower edge of the red knurled band.
- Exercise due care to prevent the expended rocket body from falling on friendly personnel or flammable materials.
- Misfired signals must NOT be approached until at least 30 minutes have elapsed after firing was attempted.

### FIRING ANGLES

2-72. Normally, this signal is held in a vertical position (90 degrees elevation) when firing. However, other angles of elevation may be used under the following circumstances:

- To compensate for high wind velocities.
- To place the signal display in a better position to be seen by search and rescue aircraft that are flying lower than the signal's maximum altitude of functioning.
- To compensate for and take advantage of widely different topographical elevations in ground-to-ground signaling, such as would be advantageous for personnel on a mountain to attract the attention of those in an adjacent valley, or for personnel in a valley to attract the attention of personnel beyond an intervening ridge or other obstruction.

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**Note.** If the signals are fired at angles of less than 90 degrees, the altitude attained is, of course, reduced, and the altitude of candle burnout is correspondingly lessened. If the firing angle is 60 degrees or less, the candle will, in almost all cases, still be burning after it strikes the surface.

---

### MAINTENANCE

2-73. When exposed to the environment, handheld signals require preventive maintenance checks and services (PMCS). The color-coded forward end seal can deteriorate if exposed to moisture for long periods of time or submerged in water. If not removed, dirt or sand can cause the handheld signal to malfunction.

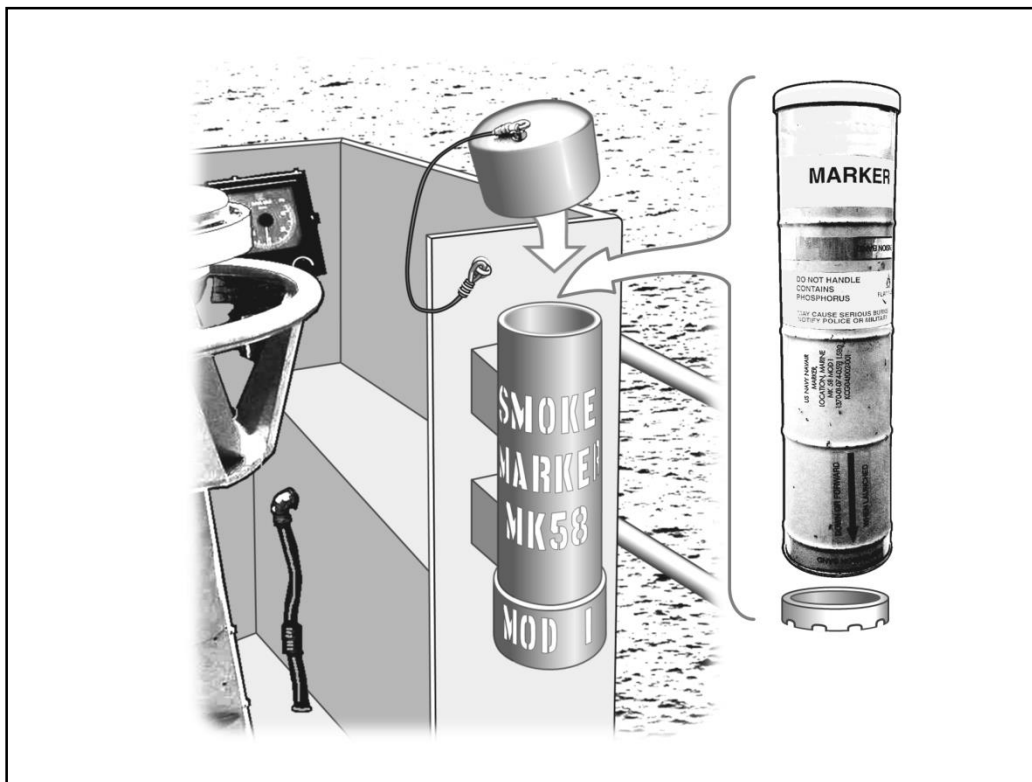
### CLEANING

2-74. To clean the handheld signal:

- Wipe the dirt off the launcher tube and the firing cap using a clean, dry, lint-free cloth.
- Use a fine-bristled camel hair brush to remove any foreign matter or debris.

## MARKER, LOCATION, MARINE, MK 58 MOD 1

2-75. This marker consists of a cylindrical tin can approximately 21.78 inches long and 5 inches in diameter. The can contains two pyrotechnic candles containing 1000 grams and 870 grams of a red phosphorus composition. The can is strengthened and the candles are supported by foamed-in-place polyurethane. The ignition end of the marker has three holes, two for smoke and flame emission and one for entry of water to the Mk 72 Mod 1 water activated battery. Adhesive foil discs hermetically seal the two emission holes and a reinforced adhesive foil strip with a rectangular pull hermetically seals the battery cavity hole. The adhesive foil seals are protected during handling and shipping by a replaceable polyethylene protective cover. A graphic depiction of the MK 58 Mod 1 marker and an example of the PVC container used for deck stowage are illustrated in figure 2-10.



**Figure 2-10. Marker, location, marine, mark (MK) 58 Mod 1 and PVC container**

## HANDLING AND STORAGE

2-76. All pyrotechnic and smoke-screening devices are designed to withstand normal handling. They should, however, be handled as little as possible to lessen the chances of damage which might cause accidental ignition or leakage. Many devices contain materials of a dangerous nature and are therefore designed with safety features which must be maintained in good operating condition. Dents, deformations, or cracks in the outer body may interfere with the proper functioning of these safety features or might cause ignition during handling or storage. It is therefore imperative that extreme care be taken to prevent damage to containers of pyrotechnics and screening devices, and to the devices themselves.

2-77. The marker will be stowed on bridge port and starboard wings in PVC container. This PVC container can be constructed by the crew. Materials needed to construct container are listed below:

- 1ea 17" piece of 6" ID PVC, schedule 40.
- 2ea 6" high pressure PVC end caps.
- 4ea #8 sheet metal screws.
- 1ea 14" long piece of 1/16" plastic coated cable.

- 2ea solder less wire connectors (for 1/16" cable).
- 1ea 4" galvanized screen door handle.

2-78. The steps for fabricating the container are listed below:

- Cut 6" ID PVC to 17" in length.
- Drill 3/8" drain hole in the bottom/center of one end cap.
- Glue end cap with the 3/8" drain hole to the bottom of the 17" length of PVC.
- Fit the second end cap to the top of the 17" length of PVC (file or sand this end so the cap can be easily removed).
- Fasten the 4" screen door handle to the top end cap using 2ea #8 screws.
- Connect the solder-less wire connectors to each end of the plastic coated cable.
- Fasten the cable to the top end cap and to the side of the 17" length of PVC using 2ea #8 screws (this is to prevent losing the cap).
- Paint container gray to match the bridge exterior, stencil "SMOKE MARKER MK58 MOD 1" on the container (white letters, 1 1/2" high).
- Use non-rusting material to mount the holder, vertically with the drain hole down, on the inside of the bridge railing next to the life ring with light (ensure that the cap can be easily removed).
- Place the marine location marker in the container with the polyethylene protective cover pointing up.
- Install the top end cap.

---

**Note.** Condensation will build up around the base of marker and the container. Vessel crews should place a non-corrosive, non-absorbent object in the base of the container to keep the marker from resting at its base on the container. Ensure that the drain hole is not blocked. **DO NOT MOUNT TO BALLISTIC STEEL**

**Note.** Due to the need for special handling, it is recommended that the MK 58 be stored in an approved ammunition or pyrotechnic locker aboard the vessel when not underway.

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### INTENDED USE

2-79. This marker is designed for day or night use in any condition calling for long-burning, smoke and flame reference-point marking on the ocean surface. It produces yellow flame and white smoke for a minimum of 40 minutes and a maximum of 60 minutes which is visible for at least three miles under normal operating conditions.

### OPERATION FOR LAUNCHING

2-80. Surface launching is usually done by hand and requires only the removal of the protective cover and the pull ring-reinforced adhesive foil strip over the battery-cavity hole before throwing the marker into the water. Perform the following steps to launch the location marker.

- Remove the polyethylene protective cover.
- Remove the pull ring reinforced adhesive foil strip.
- Throw the signal overboard with life ring. The signal will activate within 25 seconds of impacting.

### WARNING

**Entrance of water into the battery cavity of this marker will activate the electric squib which will ignite the candle. EXTERME**



**care must be exercised to avoid premature removal of the reinforced adhesive foil that seals the battery cavity. The battery must be kept dry until it is intended that the marker function.**

## **SAFETY PRECAUTIONS**

2-81. All pyrotechnic and screening devices, while designed and tested to be safe under normal conditions, can be subject to accidental ignition because of a wide variety of circumstances. The general rule to follow is: Be constantly aware that pyrotechnics contain chemical components that are intended to burn with intense heat, and act accordingly.

2-82. **Protecting the Initiation Mechanism.** Pyrotechnic and screening devices are normally equipped with some type of safety pin, lock, or tape that is designed to prevent accidental activation of the initiation mechanism. Such equipment must not be tampered with, struck, bent, or otherwise damaged; nor should it be removed until immediately before it is intended to launch the device. Any devices that show signs of damage to safety features are considered unserviceable and must be carefully segregated for prompt disposition.

2-83. **Results of Accidental Initiation.** If a pyrotechnic device is accidentally ignited, its functioning will, in all cases, result in a fire hazard. In a confined area, the gases generated by this combustion could present a serious toxic hazard. Signaling devices containing propellant charges which are designed to propel the pyrotechnic candle in to the air create an extremely dangerous missile hazard if they are accidentally ignited.

2-84. **Fighting Pyrotechnic Fires.** Pyrotechnic compositions characteristically contain their own oxidants and therefore do not depend on atmospheric oxygen for combustion. For this reason, the exclusion of air, by whatever means, from a pyrotechnic fire is usually ineffective. Many pyrotechnic mixtures, particularly illuminating flare compositions, burn with intense heat (up to 4500 degrees F). Normally available extinguishers are of little or no value in fires of this kind. It is recommended, therefore, that water, in flooding quantities and at low pressure, be used to cool the surrounding area thus to prevent the spread of the fire.

2-85. **Toxic Hazards.** Many chemicals used in pyrotechnics are poisonous if taken internally. This also applies to the residues of burned pyrotechnics. From the inhalation standpoint, the products of pyrotechnic devices and smoke generators often present a serious problem. Although many of the smokes and fumes given off by pyrotechnics and screening devices are considered non-toxic and are only mildly irritating to the eyes and nasal passages when encountered in relatively light concentrations out of doors, heavy concentrations in closely confined spaces are dangerous and may be lethal if for no other reason than that they reduce the amount of available oxygen in the air. Anything more than a brief exposure to the gases of combustion or to screening smokes should be avoided or should be protected against through the use of appropriate breathing apparatus.

## **MARINE, SMOKE AND ILLUMINATION SIGNALS, Mk 124 MOD 0 AND MK 13**

2-86. These signals are made of metal and cylinder-filled with illuminant composition in one end and smoke in the other. Each end is fitted with a plastic cap. The cap on the flare end has molded protrusions or beads on the face for night identification. The smoke (day signal) end cap is smooth. A label around the signal body further identifies each end and provides precise instructions for use. Graphic depictions of the MK 124 Mod 0 is shown in figure 2-11 on page 2-24 and the MK 13 smoke and illumination signal is shown in figure 2-12 on page 2-25.



Figure 2-11. Signal, smoke and illumination, marine, MK 124 mod 0

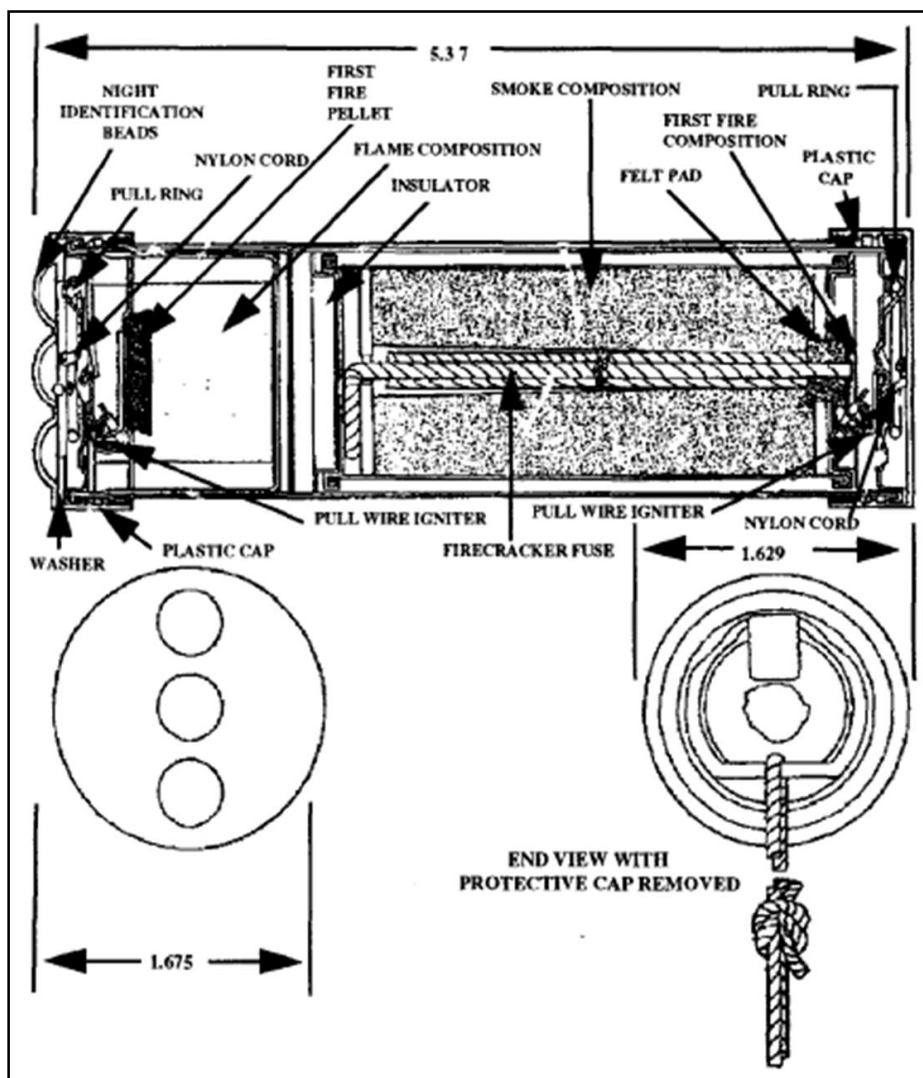


Figure 2-12. Marine smoke and illumination signal, MK 13

### Storage Locations

2-87. The smoke and illuminations signals, MK 124 Mod 0 and the MK 13 will be stored in accordance with the Watercraft Fire Control Plan for that specific vessel class.

### Intended use

2-88. This signal is intended to be used for either day or night signaling, as appropriate, by personnel on land or sea. The signal is a one-handed operable device, intended for rescue use. Its light weight (237 grams) and small size permit it to be carried in life vests and on life rafts.

### Functional Description

2-89. The lever must be extended to the armed position and then depressed to cock and release the firing pin. This action allows the striker on the firing pin to hit the primer which ignites the flare candle (night) or the smoke candle (day) depending on the display desired. The signal emits an orange smoke colored flare for approximately 20 seconds.

## Operating Instructions

2-90. After choosing the type of display desired, smoke for day or flare for night, operate the signal as follows:

### WARNING

**Don not ignite both ends of the MK 124 Mod 0 Signal at the SAME time. Prior to pulling the lever downward, position all fingers below top of signal.**

- Remove the protective cap from the end to be ignited.
- Slide the lever horizontally to the fully extended position.
- Pull the lever downward until firing pin is released.
- If the smoke-end flames, briefly immerse in water or hold against solid object.
- During and after ignition, hold signal firmly with arm fully extended overhead at an angle of 45 degrees horizontal from the body to prevent burns from hot drippings.
- DO NOT direct either end of the signal toward user or other personnel.
- After using one end, douse the signal in water to cool; if on land, place the signal on a non-combustible surface to cool. Save for use of the other end in case it is needed.

### WARNING

**Hot drippings and/or sparks from signal can cause burns and damage inflatable equipment.**

## Safety Precautions

2-91. Devices that function completely while being held in the hand must be pointed to leeward and held at arm's length and an angle of approximately 45 degrees above the horizontal to prevent burns caused by hot drippings. Under NO circumstances shall both ends of this signal be ignited at the same time.

## ANNUAL VISUAL INSPECTION

2-92. Pyrotechnics shall be inspected annually for current expiration date (if applicable), corrosion, dents, swelling or punctures, missing safety pins and caps, and the presence of chemical odors. Turn in defective or damaged pyrotechnics to the nearest Army supply facility.

## TRAINING

2-93. IAW DA Pam 350-38 STRAC, chapter 9, conduct training as follows on *Employ Distress Flares and Smoke Signals*:

- Watercraft required to carry Marker, Location, Marine, MK58, MOD1 will fire one device per vessel crew annually for training. Notification of USCG and Port Authorities is required prior to conduct of training in inland waters or within sight of another vessel. Training may be conducted at a properly equipped land based range.
- Watercraft required to carry Signal, Illumination, red star, para, M126 will fire three flares per watch section annually for crew training.
- Watercraft required to carry Sig Smk & Illum Marine MK124-0 will fire three devices per watch section annually for crew training.

- Requirement is two-fold: train crew in proper flare procedures and conduct periodic testing and replacement of smoke, flares and markers on hand.
- Active Component (AC) and Reserve Component (RC) Soldiers will conduct training once within every 12 months. No specific devices are designated for training use.

## INFLATABLE LIFE RAFTS

2-94. This section contains information about inflatable life rafts used on U.S. Army watercraft as well as life raft recertification requirements, description, location, and stowage. These life rafts include the following:

- Navy Mark 7.
- Commercial, USCG approved, 12 man.

### NAVY MARK 7

2-95. The Navy Mark 7 (Mk7) is constructed of polyurethane coated nylon fabric that is radio frequency welded making the Mk-7 very abrasion and puncture resistant with strong, durable seam construction. The periphery of the life raft bottom is arrayed with a series of weighted ballast bags that fill with water when the life raft is inflated providing stability to the life raft reducing the possibility that the raft can be capsized by wind and sea. An inflatable boarding ramp with webbing ladder projects from the life raft hull to provide easy entry from the water. In the event the life raft was to inflate upside down, a righting ladder is attached to the bottom so that one person can easily right the life raft. The Mk-7 is covered with a high visibility, double layered canopy, which can be secured, closed to protect the occupants from the weather. The canopy is equipped with a port so that a lookout can be placed to observe rescue craft with the canopy remaining closed. The canopy is also equipped with reflector tape to increase the visibility of the raft to rescue craft and a rain catchments system to collect rainwater to augment drinking water supplies. Life lines are located both inside and outside the life raft. The life raft floor is covered with an aluminized foam panel to provide the survivors thermal protection from cold sea water. The Mk-7 is equipped with a breathable air inflation system that can inflate the life raft in less than 30 seconds. The inflatable chambers have pressure relief valves to vent any excess air pressure and topping-off valves so that air can be added to maintain adequate air pressure and rigidity.

2-96. A sea anchor is deployed upon inflation to reduce drift of the life raft from the area. Once the life raft is inflated, activate flashing lights on the canopy at night to allow survivors and rescue craft to locate the life raft.

2-97. The Mk-7 life raft has a certified service period of five years. When the life raft reaches its certification expiration, it must be taken to a U.S. Navy approved life raft certification facility. Currently these are located in Portsmouth, VA, Mayport FL, San Diego, CA and Yokosuka, Japan. The U.S. Navy maintains a database that tracks all the Mk-7 life rafts. It keeps records on the life rafts' history, certifications, locations, conditions, and detailed information on vital components such as the inflation system. The database can be accessed by going to the Combatant Craft Department web site and clicking on the button for the life raft database. This web site is listed in the references section in the back of this manual. Users must request an account to be able to access the database. Access to the database can help ships keep track of their life raft assets and manage the maintenance schedules for their life rafts.

### COMMERCIAL LIFE RAFTS

2-98. Commercial life rafts must be serviced at an approved servicing facility every 12 months. The servicing facilities must be approved by the life raft manufacturer, inspected by the Coast Guard, and issued a letter of approval by the USCG Commandant. Vessel masters should give careful attention to the selection of servicing facilities for inflatable life rafts. The painter must be connected to the ship by a weak link with a 500-pound breaking strength. Each inflatable life raft and container will have permanently attached a substantial nameplate of compatible material and which is embossed or imprinted with the name of the manufacturer. The nameplate must also have imprinted the approval number, the manufacturer's model and serial number, the number of persons for which the inflatable life raft is approved, lot number, the Marine Inspection Office identification letters, the date, and the letters "USCG". The raft container will also be provided with a stainless steel plate for showing a stamped record of the data of the annual inspections and

the gas inflation tests described respectively. Particular attention should be given to life raft launching arrangements when converting to commercial life rafts. In accordance with DA Pam 750-8, para 3-8, request a special mission modification. Commercial life rafts are authorized only on 900 series small tug, forward deployed vessels, or other small vessels as designated by the Marine Safety Office. The theater support vessel uses a modified commercial marine evacuation system for rapid evacuation of large numbers of passengers.

2-99. Commercial life rafts have an annual recertification requirement plus a five year, in five year increments, (from date of manufacture) inflation test recertification. Any U.S. Coast Guard approved commercial life raft maintenance facility can conduct recertification.

## **Location And Stowage**

2-100. Inflatable life raft stowage should be located to provide the following for each life raft:

- Stowed so that when the vessel sinks the survival craft floats free and, if inflatable, inflates automatically.
- Stowed in a position that is readily accessible to crewmembers for launching in less than 5 minutes, or provided with a remotely operated device that releases the life raft into launching position or into the water.
- Stowed in a way that permits manual release from its securing arrangements, without shifting in its mount.
- Ready for immediate use so that crewmembers can carry out preparations for embarkation and launching.
- Stowed in a way that neither the life raft nor its stowage arrangements will interfere with the embarkation and operation of any other life raft at any other launching station.
- Stowed in a way that any protective covers will not interfere with launching and embarkation.
- Stowed, as far as practicable, in a position sheltered from breaking seas and protected from damage by fire.

2-101. A mechanical, manually operated device to assist in launching a life raft must be provided if:

- The life raft weighs more than 90.7 kilograms (200 pounds); and.
- The life raft requires lifting more than 300 vertical millimeters (one vertical foot) to be launched.
- To permit ready manual overboard launching into the water without hitting obstructions.
- To be clear of overhead obstructions.
- To avoid the effects of heavy seas.
- To interfere as little as possible with normal shipboard activity.
- They shall be located, longitudinally, where they will provide the maximum practical distribution of lifesaving facilities. Furthermore, instructions shall be plainly visible and the station lighted by the vessels emergency lighting system.

## **Securing**

2-102. Equipment for securing the life rafts in their stowage mounts will include a hydrostatic release assembly that permits automatic and manual release. This provides for quick release of the life raft from its stowage for manual launching, or release from its stowage from hydrostatic pressure, resulting from a depth of 10 to 40 feet of seawater.

2-103. The Navy MK 7 life raft sea painter should be tied or lashed to the ship in any manner. The Navy life raft sea painter will detach from the life raft upon completion of inflation.

2-104. Commercial life rafts need to secure their sea painter with a float free link (weak link) permanently attached to the vessel. The sea painter remains with the life raft.

## **PAINTERS**

2-105. There are three types of painters used with life rafts and rescue boats; painter, sea painter, and bow painter. Although they are similar, they each have different purposes.

2-106. In general a painter is a line used for securing or towing a boat. Painters are used primarily on life rafts to secure them to another boat or pier.

2-107. The sea painter is a line used to launch a rescue boat while the launching vessel is underway and making way. Sea painters are used mainly on rescue boats to control the boat as it become waterborne and to direct it away from the vessel as the vessel moves through water.

2-108. The bow painter is a short piece of line secured at the bow area of a small boat. Bow painters are used to make it fast to the larger vessel. Bow painters are also known as tag lines.

### CAUTION

Rubber stoppers are inserted into the end of the sea painter line assembly to prevent entry of water into the life raft assembly and prevent accidental pay out of the painter line from its internal spool. If the stopper falls out, it is possible for high winds or seas to cause the entire 100' of spooled line to pay out, thus rendering the life raft inoperable, requiring its removal and transfer to a Navy repair facility for replacement of the sea painter spool. Properly installed rubber stoppers should be inserted until 1/8" to 1/16" of the stopper is visible uniformly about the circumference of the stopper on the outside of the life raft container. If there is 1/4" or more of the rubber stopper exposed outside the life raft container, there is insufficient interference between the stopper and hole to prevent the stopper from coming loose in heavy weather. In no case shall the stopper be pushed flush or into the assembly.

## MARKINGS

2-109. Markings on life rafts shall be clearly and legibly applied in a color contrasting to its background. Required markings are vessel hull number, "U.S. ARMY", life raft number and capacity on the outer protective shell. Use materials that are permanent for the life of the inflatable life raft. Place instructions for launching and inflating the raft, righting the raft, and so on, in a conspicuous lighted area near the life raft. Recertification dates are located in the container handholds or under the black moisture band by the painter stopper. Stencil the life raft number and its capacity on the vessel's deck so it is visible underneath the life raft.

## RELEASE LIFESAVING EQUIPMENT

2-110. This section contains information on operation and installation of Release Lifesaving Equipment used on U.S. watercraft. This consist of the Release Lifesaving Unit (Thanner DK84.1-M)

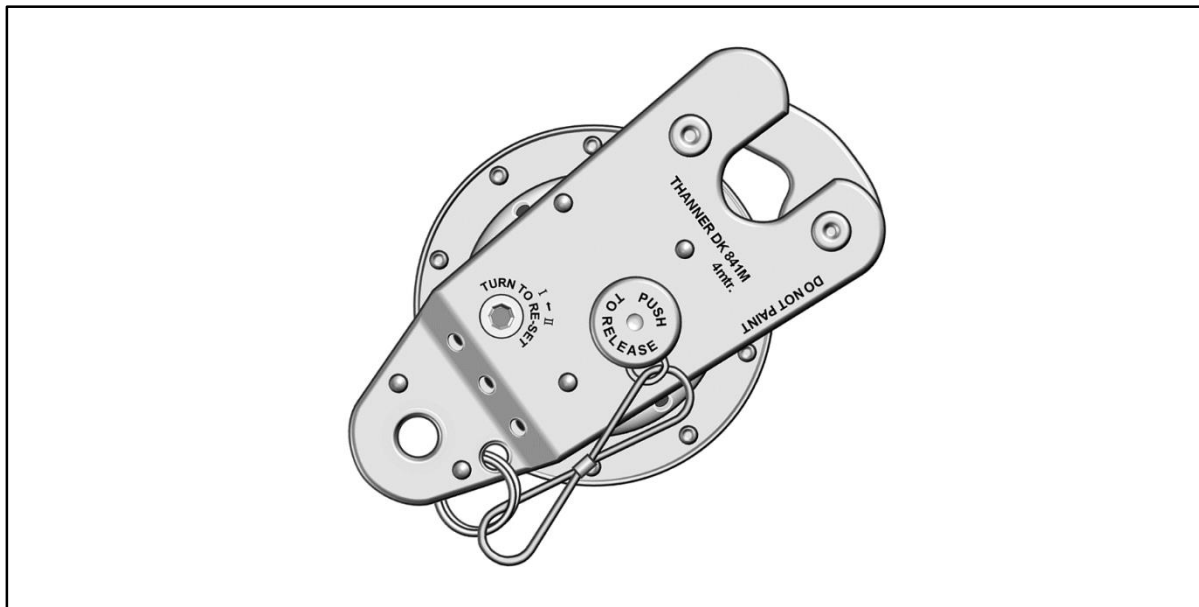
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*Note.* The Release Lifesaving Equipment is also referred to as Hydrostatic Release Units.

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### Release Lifesaving Unit

2-111. The Hydrostatic Release Unit, Navy Can, NSN 4220-01-279-7287, has been discontinued. The replacement for the hydrostatic release is the Release Lifesaving Equipment. All existing hydrostatic releases must be replaced by the Thanner Hydrostatic Release Unit DK84.1-M, NSN 4220-01-493-9233. See figure 2-13 on page 2-30.



**Figure 2-13. Release Lifesaving Unit (Thanner DK84.1-M)**

2-112. The Navy calls for the Release Lifesaving Equipment to be recertified every 5 years. This is the same time frame as for the life rafts. The following outlines installation procedure as well as maintenance and inspection criteria for the Release Lifesaving Equipment.

2-113. To replace the Release Hydrostatic, NSN 4220-01-279-7287 (Navy Can) with Release Lifesaving Equipment, NSN 4220-01-493-9233, Thanner DK84.1-M:

- Remove previously installed Release Hydrostatic.
- Install the Release Lifesaving Equipment by connecting the fixed end to the cradle or ship's structure and the release pawl end to the retaining harness with PUSH TO RELEASE plunger facing inboard.
- Ensure that the safety pin is installed to avoid inadvertent release.
- Tighten the retaining harness until the life raft is securely seated in the cradle, but not so much as to damage the life raft container.

2-114. To activate the Release Lifesaving Equipment:

- Remove safety pin.
- Strike the PUSH TO RELEASE plunger with the palm of your hand to free the release pawl.

2-115. To reset the Release Lifesaving Equipment:

- Insert an 8 mm Allen wrench into the TURN TO RE-SET well and turn it counterclockwise from the II to I position until an audible click is heard. This indicates that the release pawl is reset to the locked position.
- Install safety pin.

2-116. Inspect the Release Lifesaving Equipment Jaw Engagement Orientation (PMSC-Before and Monthly)

- Ensure that both jaws of the hydrostatic release are fully engaged in the locked position
- Inspect the hydrostatic release device orientation to ensure that the fixed end is connected to the deck/cradle and the release pawl end is connected to the retaining harness
- Ensure that the hydrostatic release device is installed with the PUSH TO RELEASE plunger facing inboard

2-117. Inspect the Release Lifesaving Equipment (PMCS-Before and Monthly).



- Inspect device for damage, distortion, corrosion, or missing parts. Replace corroded, damaged, or missing components or the entire unit as necessary.
- Inspect external surfaces for paint or lubricants.
- Inspect static ports for clogging. Paint or lubricant on external surfaces may clog static ports and prevent release device from operating.
- Inspect connecting linkage for corrosion, cracks, distortion, and burrs.
- Inspect safety pin for corrosion and installation.
- Inspect plunger for clogging or distortions by pushing on the plunger with the safety pin installed. Service as required.
- Inspect diaphragm halves mounting bolts for loose or missing bolts or nuts.
- Inspect device for damage, distortion, corrosion, or missing parts. Replace corroded, damaged, or missing components or the entire unit as necessary.

2-118. As previously mentioned, recertification of the Release Lifesaving Equipment is required every five years. Recertification can be accomplished by Authorized Commercial Recertification Centers and at the naval facilities listed below. Shipping must be funded to and from point of destination.

- Mid-Atlantic Regional Maintenance Center (MARMC)  
Commanding Officer  
Norfolk Naval Shipyard  
Life Raft RRC Bldg. 369  
Portsmouth, VA 23709  
Phone: 757-396-2057
- South-East Regional Maintenance Center (SERMC)  
Bldg. 1488 Code 937G  
N.S. Mayport, FL 32228  
Phone: 904-270-5126 Ext. 3171
- South-West Regional Maintenance Center (SWRMC)  
Commanding Officer ATTN: BMC Jones 937G  
U.S. Naval Station  
3985 Cummings Road Bldg. 116  
San Diego, CA 92136  
Phone: 619-556-2957
- U.S. Naval Ship Repair Facility (USNSRF)  
Nobuhiro Takanshi  
Code C-310H  
PSC 473 Box 8  
FPO AP 96349-0008  
Phone: 011-81-46-816-5235/5814

## EMERGENCY ESCAPE BREATHING DEVICE

2-119. Emergency Escape Breathing Device (EEBD) is a self-contained respiratory protection system in atmospheres containing toxic gas or in atmospheres that do not have enough oxygen. The Ocenco EEBD provides enough air for personnel to escape from below decks to the weather deck. It can be wall mounted (orange case) or belt-worn to provide quick and easy access in emergency situation. Ocenco EEBD unit is a phased replacement to the SCOTT EEBD unit. Ocenco EEBD unit provides air through a mouthpiece unlike the SCOTT EEBD, which provides air into a hood. The EEBD will also provide oxygen to trapped personnel awaiting rescue in contaminated atmospheres. The clear Teflon hood provides excellent heat and chemical protection. The Ocenco M-20.2 EEBD consists of the following (which are illustrated in figure 2-14 on page 2-33):

- Nose Clip – the yellow nose clip is permanently attached to the mouthpiece.

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**NOTE.** National Institute for Occupational Safety and Health requirement is to use the nose clip in conjunction with mouthpiece.

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- Oxygen Cylinder – stainless steel cylinder holds 100% medical grade oxygen. Holds 27 liters of oxygen.
  - Oxygen Regulator – starts the flow of oxygen and regulates the oxygen flow during high work rates.
  - Activation Cable – stainless steel activation cable is attached to the oxygen regulator and permanently attached to the inside of the clear base, once it is disconnected from the case, oxygen will flow immediately.
  - Gauge – indicates the amounts of oxygen in the cylinder. The green zone indicates unit is ready for use. The red zone indicates the cylinder is low on oxygen and should be removed from service.
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**Note.** Two different configurations of gauges are being supplied by Ocenco. One is dial type and the other is coil type.

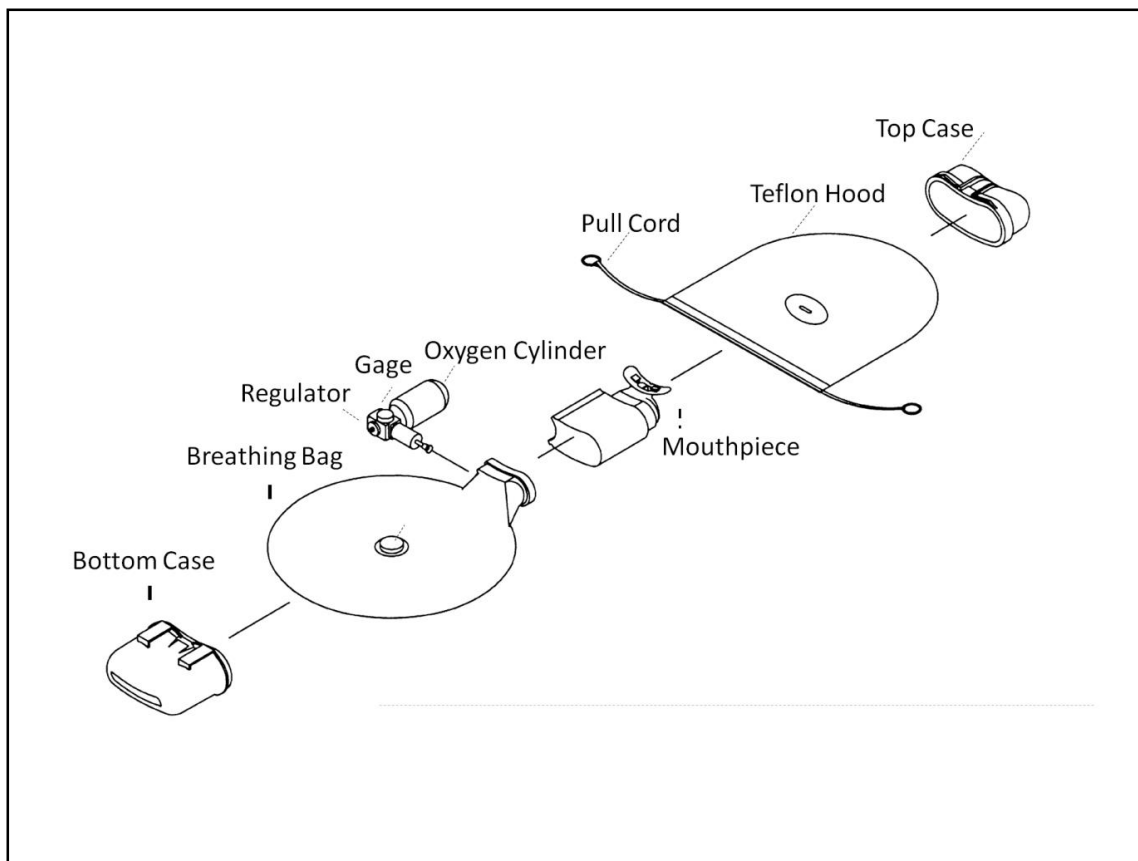
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- Breathing Bag – an air reservoir that receives oxygen from the oxygen regulator and exhaled air from the scrubber.
- 

**Note.** Two different colored breathing bags are available: Black and Tan, Kevlar type.

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- Relief Valve – a one-way valve automatically allows excess air in the bag to vent.
  - Face Shield – optional.
- 



**Figure 2-14. Emergency Escape Breathing Device (EEBD) expanded view**

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*Note.* The optional face shield is to help protect face and eyes from smoke or chemical vapor.

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### WARNING

**The EEBD is not to be confused as a fire-fighting device, such as the breathing apparatus (BA). It is to be strictly used as an emergency escape device. Improper use of this equipment may result in injury or death. Personnel should receive adequate training prior to use, including the limitations to which the equipment is subject. Personnel are reminded that there is no substitute for alertness, common sense, and self-discipline.**

2-120. The EEBD is rated by National Institute for Occupational Safety and Health for a minimum of ten minutes of operation.

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*Note.* Testing has shown that unit can last between 15 and 20 minutes depending on breathing rate and up to 32 minutes, if user is trapped and waiting rescue. The unit can be donned and activated in 10 seconds. Activation is accomplished by pulling the unit from its case, which will automatically start oxygen flow. Once activated, the unit cannot be shut off. It is a single use, disposable unit.

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The service life of an EEBD is 15 years. It can be belt-worn continuously for 5 years in engineering machinery spaces or confined spaces before returning to a wall mounted bracket for the remainder of its service life. The weight of the breathing apparatus is 1.98 lbs.; the apparatus with case 2.87 lbs. The maximum operating temperature is 140 degrees F and the minimum is 10 degrees F.

## OPERATING PROCEDURES

2-121. The following instructions will enable users to familiarize themselves with those procedures which are necessary to operate the escape device in actual in-service conditions. These instructions will also describe the capabilities and limitations of the equipment in so far as the user is concerned.

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*Note.* When donning from orange stowage case, place unit on ground with orange pull-tab away from body. Open orange stowage case, lift yellow lever, remove unit, discard cover case and follow steps below.

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- Lift yellow lever and discard cover case.
- Remove unit by pulling on yellow neck strap upward, starts oxygen flow.
- Put yellow neck strap over the wearer's head.
- Insert yellow mouthpiece into mouth.

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*Note.* Make sure the nose clip is flipped out before inserting yellow mouthpiece into mouth to ensure that wearer of unit does not breathe through nose while in toxic atmospheres.

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- Fit yellow nose clip.
- Inhale through mouth and escape.
- Fit and adjust yellow neck strap and face shield by pulling on O-rings for a secure fit.

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*Note.* Face Shield is optional, to protect faces and eyes from smoke and fire.

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### **WARNING**

**The EEBD is a onetime use throw away device. Dispose of the EEBD immediately after use. Failure to comply could result in serious injury or death.**

## **REMOVING AND DISPOSAL**

2-122. Once the wearer is clear of the hazardous area the following steps indicate how to properly remove and disposition the device:

- Loosen neck strap.
- Pull forward overhead.
- Remove unit.
- Turn into Unit Hazmat for disposal.

## **MAINTENANCE**

2-123. Maintenance will be conducted IAW Army Regulations and manufactures guidelines. The EEBD, whether wall mounted or belt-worn, should be inspected for any indications of high force impact. Check to make sure unit does not have:

- Case cracks.
- Burns.
- Deformities.
- Excessively worn parts.
- Damaged latch or cover band.
- Bent gauge.
- Broken indicator needle.
- Dirt, debris or moisture visible through gauge window.
- Broken belt loops.
- Missing tamper indicating ball.

2-124. If any of these indications of high force impact are observed, or if the pressure gauge is out of the green zone, remove unit from service. To ensure top condition, always provide best possible care and follow PMCS procedures.

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*Note.* Manufactures' warranty is voided once the EEBD is opened and the red tab is missing or has been pulled. Additionally, lifting the yellow lever on the EEBD breaks the seal (red tab) and also voids the manufactures' warranty.

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## **SERVICE LIFE**

2-125. The Ocenco EEBD has a service life of 15 years from the date of manufacture, provided the conditions of use are observed. The Ocenco EEBD must be either stored in the orange stowage container or belt worn. The Ocenco EEBD may be deployed in the belt worn configuration for five continuous years during its 15 year service life.

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*Note.* EEBD cases should be marked with vessel name or number.

*Note.* EEBD canisters must be disposed of IAW HAZMAT/Environmental SOP.

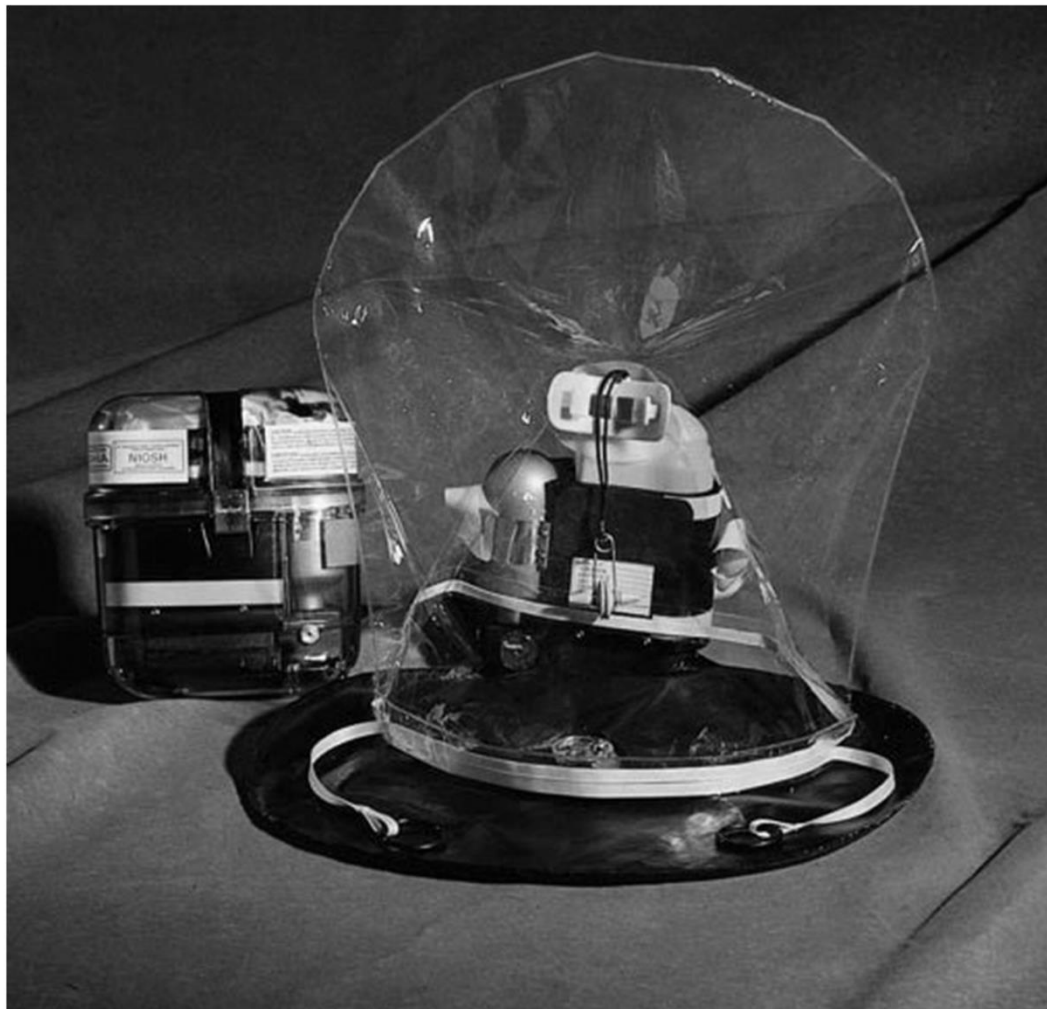
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## TRAINING EEBD

2-126. The training EEBD is light blue and comes in a light blue stowage case. It comes equipped with three mouthpieces. It does not come equipped with a Teflon hood, ten minute supply of oxygen, or a lithium hydroxide scrubber. The training EEBD is illustrated in figure 2-15 on page 2-36.

2-127. There are three way to order the training video from Ocenco:

- Telephone: (262) 947-9000, FAX: (262) 947-9020.
- E-mail: [eebd@ocenco.com](mailto:eebd@ocenco.com).
- Ocenco web site which is provided in the references section in the back of this manual.



**Figure 2-15. Training EEBD**

## STRETCHERS AND LITTERS

2-128. Information on the different types of stretchers and litters used to transport injured personnel onboard Army watercraft is provided in the following paragraphs.

### **WARNING**

**Operating, procedures and techniques as well as Maintenance/Inspection services and procedures MUST be complied with to prevent personnel Injury, Loss of Life or Damage to Equipment.**

## **STORAGE LOCATIONS**

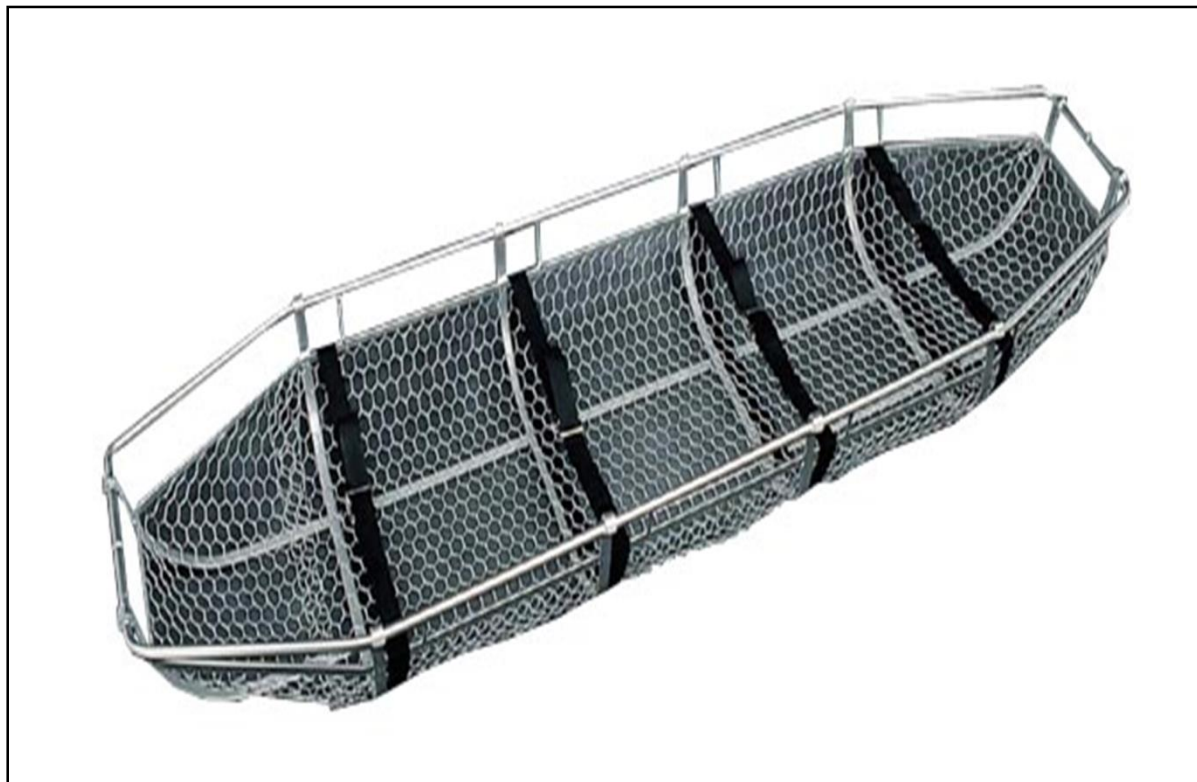
2-129. Storage locations for the various stretchers and litters used aboard Army watercraft will be in accordance with the vessel's Fire Control Plan.

## **STOKES LITTER**

2-130. This section contains information about the corrosion-resistant steel stokes litter.

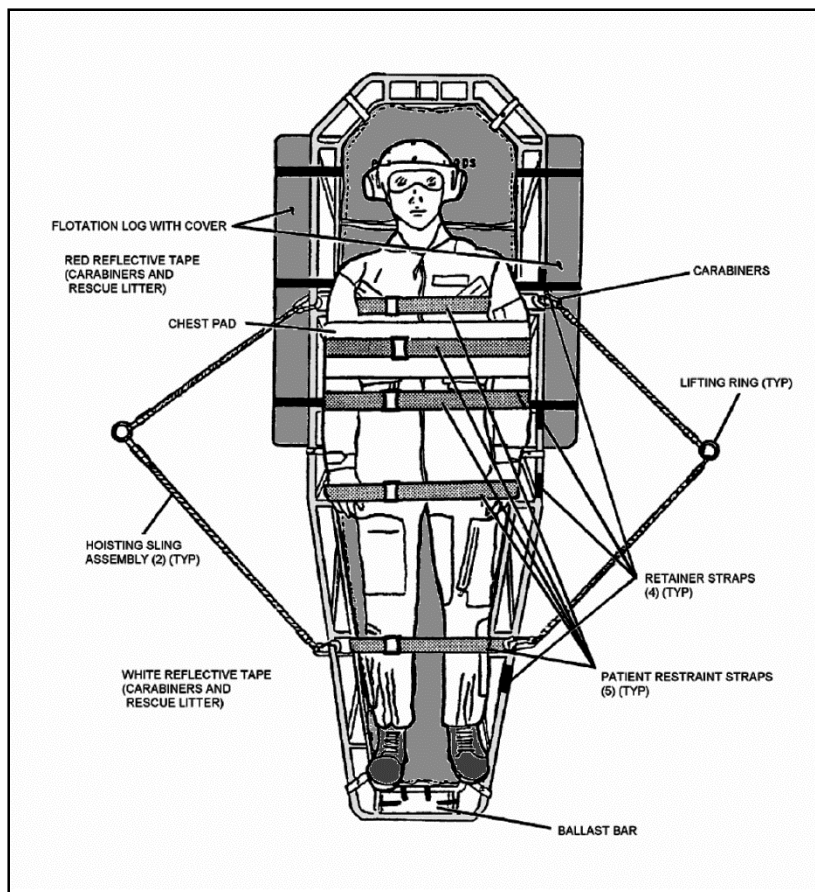
### **Configuration**

- 2-131. Stokes litters shall be configured for their intended application and shall not be used otherwise.
- Ashore-Stokes litters used for transporting a person for land operations require no modifications. Steel or aluminum litters such as depicted in figure 2-16 may be used.



**Figure 2-16. Stokes litter (Ashore configuration)**

- Over Water-Stokes litters used for transporting a person onboard boats, over the water, or retrieving a person overboard, shall be configured with a flotation kit assembly (includes tow flotation tubes with covers, one chest pad with cover, five restraint straps, and one ballast bar), slat set, hoisting slings, and tending lines (see figure 2-17 on page 2-38).



**Figure 2-17. Stokes litter (Over water and hoist ready)**

- Hoisting-Stokes litters intended for shipboard or helicopter-hoisting operations (using the ship's or aircraft's hoist) shall be equipped with the standard hoisting sling.
- Hoisting sling assembly is constructed of two sets of stainless steel 5/32-inch cables. Each cable set contains two lengths of cable (33 inches and 41 inches), which are attached to one another by a 1 1/2 -inch by 5/16-inch stainless steel lift ring. Each cable set has a pair of thimbles, two swaging sleeves, and two color coded locking carabiners. The 33-inch cable is attached to the head of the litter by the red color coded carabiner, and the 41-inch cable is attached to the foot of the litter by the white color coded carabiner.

### WARNING

**Only steel litters are authorized for hoisting operations. Improper use of the Stokes Litter could result in damage to equipment, injury or death.**

*Note.* Class "A" Army watercraft shall maintain at least one corrosion resistant steel Stokes litter rigged for over water use. Class "B" and "C" Army watercraft may maintain at least one corrosion-resistant steel Stokes litter rigged for over water use.

## Modifications

- 2-132. The following paragraphs describe modifications to the Stokes litter.
- 2-133. To attach the flotation tubes, chest pad, and ballast weight, complete the following steps:
- Route one end of the flotation tube webbing tie over the top (3/4-inch) litter tube and the other end of webbing tie under the lower (3/8-inch) litter tube.
  - Be sure to position ties over the outside of the flotation tube and in the location illustrated in figure. 2-17 on page 2-37.
  - Tie or connect ends of webbing together using a square knot or buckles (if so equipped). Tack free ends of webbing using 6-cord nylon thread.
  - Route chest pad strap through retainer straps on cover and attach to the lower (3/8-inch) litter tube as illustrated in figure 2-17 on page 2-37.
  - To make litter self-righting, attach a 12-pound ballast bar to foot of litter.

### WARNING

**It is essential that the two flotation tubes, chest pad, and ballast bar be positioned at the precise locations on the litter as noted in instructions. If the tubes are positioned too high or too low, the litter may not right itself or keep the patient's head above water.**

- 2-134. Attach the hoisting sling.

### WARNING

**Use two swaging sleeves on each end of the hoisting sling when attaching it to the litter tube.**

- 2-135. Attach four restraint straps. To attach straps to the 3/8-inch tube, pass loop end of restraint strap around outside and under tube, passing strap between wire mesh and tube. Pass opposite end through loop and pull strap tight.

- 2-136. Stokes litters shall have tending lines installed so the litter can be held in position and recovered from alongside a vessel for rescue from the water. Use manila line of sufficient length to allow lowering of litter to the water. Attach tending lines using an eye splice, to the 3/4-inch tubes at stations 3 and 6 of litter.

## INSPECTION

- 2-137. Stokes litters and associated equipment shall be inspected after each use but not less than once every three (3) months. The latest date of inspection and proof test shall be stenciled on the bottom of the slat set (in trunk section of litter). The stencil shall be of 1/2-inch letters.

- 2-138. The following paragraphs contain requirements for inspection of the litter, flotation equipment, hoisting sling, and tending lines.

- 2-139. Litter. Inspect litter for cracked welds, cracked tubes, rust, pinholes, security and condition of wire mesh, and evidence of wear on the sling attachment points. Inspect restraint straps for security, condition, and quantity (minimum of four per litter).

- 2-140. Flotation Equipment. After use in salt water, flotation equipment shall be rinsed in fresh water and dried before storage. Flotation equipment shall be thoroughly inspected for wear, rotting, mildew, mold, tears, cuts, broken stitches, and frayed fabric.



2-141. Hoisting Sling. The hoisting sling shall be inspected for corrosion, fraying, or deterioration. The hoisting requires test loaded certification every 6 months.

2-142. Tending Lines. Inspect manila tending lines for condition and security. Lines that are frayed or show signs of weathering or rot shall be replaced.

## PROOF TESTING

2-143. Litters equipped with a hoisting sling shall be proof tested every 6 months. To proof test litter, complete the following steps:

- Distribute 500 pounds evenly in the litter and hoist clear of the deck.
- With litter suspended, inspect litter and sling for deformities.
- Inspect sling for even load distribution at all attachment points.
- Hoist the litter (while loaded) a few inches off the floor for a minimum of 30 minutes.

## MAINTENANCE

2-144. Maintenance of the litter, hoisting slings, flotation equipment, and chest pad consists of minor repairs, replacement, and cleaning. Repairs for aluminum litters are limited to removal of surface corrosion and application of primer to rework areas. Cracked welds or cracked tube members are cause for replacement. To maintain equipment, complete the following steps:

### WARNINGS

**No weld repairs shall be attempted on aluminum litters. Aluminum litters shall be marked "NOT TO BE USED FOR HOISTING OR HIGH-LINE OPERATIONS."**

- Weld repairs for steel litters are permitted using heliarc method only. After a weld repair, litter shall be proof tested as described in paragraph.
- Replace hoisting slings that show signs of corrosion, fraying, or deterioration.
- After each use in salt water, remove flotation collar and chest pad from the litter, rinse in fresh water, and dry before reinstallation.

## MILLER FULL BODY SPLINT/LITTER

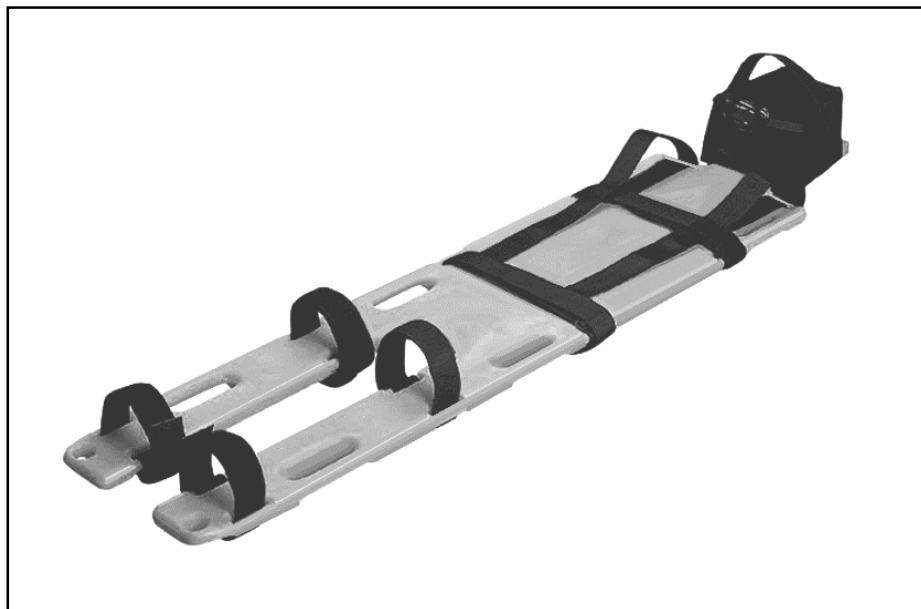
2-145. The Miller full body splint/litter is designed for removing an injured person from engine room spaces, holds, and other compartments. This is used where access hatches are too small and through narrow passageways and ladder wells to permit the use of regular stretchers or litters. This litter is authorized for use on U.S. Army watercraft.

### Description

2-146. The Miller Full Body Splint/Litter (NSN 6530-01-193-5037) is a versatile spine immobilization board and litter that comes complete with a full head and body harness (see figure 2-18 on page 2-41). This unique harness system will allow a victim to be rotated onto his side for proper airway management or extraction without jeopardizing spinal position. An optimal helmet harness allows this same critical immobilization of a helmeted victim. The Miller board can be used for safe vertical lifting in normal and confined space rescue without compromising patient safety or spine immobilization. The unique features of the Miller Full Body Split/Litter are listed below.

- Rigid foam core provides both strength and buoyancy for water rescue immobilization. The board will float 250 pounds in fresh water and 300 pounds in salt water.
- Strapping system allows the rescuer to immobilize and restrain combative patients.

- Split-leg design allows for easy independent leg traction, accessibility, and compatibility with the Stokes basket litter.
- Shoulder strap design prevents both lateral and horizontal movement of the patient during extrication and transportation.



**Figure 2-18. Miller Full Body Splint/Litter.**

### Stowage

2-147. Stretchers of this type should be kept onboard in appropriate places ready for use.

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**Note.** The Neil Robertson stretcher is being phased out and will be replaced by attrition with the Miller Full Body Splint. The picture of the Miller Full Body Splint/Litter shown in figure 2-18 is courtesy of the manufacturer, Allied Healthcare Inc.

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## LINE THROWING DEVICE

2-148. This section will cover the requirement, stowage, and safety precautions pertaining to the throwing device used aboard army watercraft.

### SHOULDER GUN EQUIPMENT

2-149. The shoulder gun type (herein also called the U.S. “appliance”) used aboard U.S. Army watercraft is required to have the following equipment carried for each shoulder gun:

- Ten service projectiles.
- Twenty-five cartridges.
- Four service lines.
- One cleaning rod with brush, one can of oil, and 12 wiping patches.
- One set of instructions from the manufacturer.
- One auxiliary line that is made of one of the following:

- Manila and is at least 500 feet long and 3 inches or more in circumference; or A synthetic material and is at least 500 feet long, is certified by the manufacturer to have a minimum breaking strength of 9,000 pounds, and inhibited to resist the effects of ultraviolet rays.
- In the event that a vessel is deployed forward of its home base, a SOLAS standard line-throwing device can be procured and utilized when items within the DOD procurement system cannot be obtained.

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**Note.** All equipment must be stowed with the appliance in a box or case, except for the service lines and the auxiliary line, which may be stowed in an accessible location nearby.

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## **DRILLS**

2-150. It is the duty of the vessel master to drill the crew in the use of the appliance. The device is to be exercised at least once every quarter. Test firing may be accomplished using the regular cartridge and projectile with any flexible line of proper size and lengths, suitably faked or laid out. Due care is required to ensure vessel retains adequate supply on board. Vessels must log exercise of all safety equipment IAW paragraph 1-35 of this manual.

## **ACCESSIBILITY**

2-151. The line throwing appliance and its equipment will be kept easily and readily accessible and ready for use. No part of this equipment will be used for any other purpose. When firing the appliance, the operating instructions and safety precautions furnished by the manufacturer shall be followed.

### **WARNING**

**As with any firearm or firing mechanism, the appliance should be handled with caution and only when its use is required. Misuse of this piece of equipment could cause personal injury or death.**

## **TRAINING**

2-152. IAW DA Pam 350-38 STRAC, chapter 9, conduct training as follows: Mk1 Line-throwing Device Water Crew Training Standards and Strategies:

- The assigned or attached vessel crews of the logistics support vessel (LSV), small tugboat (ST) and large tugboat (LT) will train on the line-throwing device quarterly.
- Mk1 line-throwing device operational test firing, required quarterly in accordance with AR 56-9, should be conducted in conjunction with training. Regardless of number of crews available, no less than three test shots of the line-throwing device will be conducted per quarter.
- Test firing and Soldier training will be annotated in the vessel log.
- AC and RC Soldiers will meet training requirements once every three months.

## **RESCUE BOAT**

2-153. The following paragraphs provide detailed information on the requirements for rescue boats. Included in this section is stowage information and the equipment that is required to be on the rescue boats.

## **STOWAGE AND EQUIPMENT**

- Rescue boats must be stowed.
- To be ready for launching in not more than 5 minutes.

- In a position suitable for launching and recovery.
- In a way that neither the rescue boat nor its stowage arrangements will interfere with the operation of any survival craft at any other launching station.

2-154. Each rescue boat must have a means provided for recharging the rescue boat batteries from the vessel's power supply at a supply voltage not exceeding 50 volts.

2-155. Each inflated rescue boat must be kept fully inflated at all times.

2-156. The rescue boat equipment list (see table 2-3 below and continuing on pages 2-44) is for all the equipment that must be included with the rescue boat.

**Table 2-3 Rescue Boat Equipment List**

<b>Item</b>	<b>Remarks</b>
Bailer	The bailer must be buoyant.
Boathook	In the case of a boat launched by falls, the boathook must be kept free for fending-off purposes.
Compass	The compass and its mounting arrangement must be approved under USCG approval series 160.014. In an entirely enclosed life raft, the compass must be permanently fitted at the steering position, in any other boat, it must be provided with a binnacle, if necessary to protect it from the weather, and with suitable mounting arrangements.
Fire extinguisher	The fire extinguisher must be approved under USCG approval series 162.028. The fire extinguisher must be type B-C, size II or larger. Two type B-C size I fire extinguishers may be carried in place of a type B-C, size II fire extinguisher.
First aid kit	The first aid kit in a life raft and rescue boat must be approved under USCG approval series 160.041. The USCG Approval Series web site is provided in the reference section in the back this manual.
Flashlight	Flashlight must be a type I or type III that is constructed and marked in accordance with the American Society of Testing and Materials (ASTM) F1014. One spare set of batteries and one spare bulb, stored in a watertight container, must be provided for each flashlight.
Heaving line	Heaving line must be buoyant, must be at least 30 meters (99 feet) long, must have a buoyant rescue quoit attached to one end, and should be at least 8 millimeters (5/16 inches) in diameter.
Knife	The knife must be of the non-folding type with a buoyant handle as follows: the knife in an inflated or rigid inflated rescue boat must be of a type designed to minimize the possibility of damage to the fabric portions of the hull. [A HATCHET COUNTS TOWARDS THIS REQUIREMENT IN RIGID RESCUE BOATS]
Ladder	The boarding ladder must be capable of being used at each entrance on either side or at the stern of the boat to enable persons in the water to board the boat. The lowest step of the ladder must not be less than 0.4 meters (15.75 inches) below the boats waterline.
Oars and paddles	Each life raft and rescue boat must have buoyant oars and paddles of the number, size, and type specified by the manufacturer of the boat. An oarlock or equivalent device, either permanently installed or attached to the boat by a lanyard or chain, must be provided for each oar. Each oar should have the vessel's name marked on it in block letters. [A UNIT OF OARS MEANS THE NUMBER OF OARS SPECIFIED BY THE BOAT MANUFACTURER]. [RESCUE BOATS MAY SUBSTITUTE BUOYANT PADDLES FOR OARS, AS SPECIFIED BY THE MANUFACTURER].

Table 2-3 Rescue Boat Equipment List (*Continued*)

<b>Item</b>	<b>Remarks</b>
Painter	One painter on a life raft and the sea painter on a rescue boat must be attached by a painter release device at the forward end of the life raft. If the painter is of synthetic material, the painter must be of a dark color or certified by the manufacturer to be resistant to deterioration from ultraviolet light. The painter for a life raft and each painter for a rescue boat must be of a length the is at least twice the distance from the stowage position of the boat to the waterline with the vessel in its seagoing condition, or must be 15 meters (50 feet) long, whichever is greater. The painter must also have a breaking strength of at least 34 kilonewtons (7,700 pounds-force).
Pump	The pump or bellows must be manually operated and should be arranged so it is capable of inflating any part of the inflatable structure of the rescue boat. [NOT REQUIRED FOR A RIGID RESCUE BOAT]
Radar reflector	The radar reflector must be capable of detecting at a distance of 4 nautical miles and must have mounting arrangements to install it on the boat in its proper orientation. A 9 –Gigahertz radar transponder may be substituted for the radar reflector in the transponder is accepted by the Federal Communications Commission as meeting the requirements of Title 47 CFR, part 80 and is stowed in the boat or raft.
Repair kit	The repair kit for an inflated and rigid-inflated rescue boat must be packed in a suitable container and include at a minimum; a.) Six sealing clamps, b.) Five 50-milimeter (2-inch) diameter tube patches, c.) Roughing tool, and d.) Container of cement compatible with the tube fabric. The cement must also have an expiration date on its container that is not more than 24 months after the manufactured date of the cement. [NOT REQUIRED FOR A RIDIG RESCUE BOAT]
Sea anchor	The sea anchor for a rescue boat must be of the type specified by the rescue boat manufacturer, and must have a hawser of adequate strength that is at least 10 meters (33 feet) long.
Sponge	Sponge must be suitable for soaking up water. [NOT REQUIRED FOR A RIGID RESCUE BOAT]
Thermal protective aid	The thermal protective aid must be approved under approval series 160.174. [SUFFICIENT THERMAL PROTECTIVE AIDS ARE REQUIRED FOR AT LEAST 10% OF THE PERSONS THE SURVIVAL CRAFT IS EQUIPPED TO CARRY, BUT NOT LESS THAN TWO]
Whistle	Whistle must be corrosion-resistant, and should be a ball-type or multi-tone whistle that is attached to a lanyard.
<b>Additional Rescue Boat Equipment</b>	<b><i>The following is a list of additional rescue boat equipment that is required per Titles 33 and 47 Code of Federal Regulations (CFR) as noted</i></b>
Becketed Lifelines	Installed both inside and outside of Safety of life at sea (SOLAS) approved rescue boats
Horn	Mounted (Title 33 CFR requirement)
Navigation lights	Mounted (Title 33 CFR requirement)
Radio	(Mounted or portable (Title 47 CFR requirement)
Personal Flotation Devices	For entire crew
Pyrotechnics	Six (6) Signal, Smoke, and Illumination, Marine, MK 124 Mod 0

2-157. All rescue boat equipment not integral with the hull will be marked “U.S. Army” and with the vessel name/number.

## **LAUNCHING AND RECOVERY ARRANGEMENTS**

2-158. Each rescue boat embarkation and launching arrangement must permit the rescue boat to be boarded and launched in the shortest time possible. If the launching arrangement uses a single fall, the rescue boat may have an automatic disengaging apparatus release mechanism. Rapid recovery of the rescue boat must be possible when loaded with its full complement of persons and equipment. Each rescue boat launching appliance must be fitted with a powered winch motor. Each rescue boat launching appliance must be capable of hoisting the rescue boat when loaded with its full rescue boat complement of persons and equipment at a rate of not less than 0.25 meters per second (0.5 knots or 50 feet per minute).

## **MARKINGS ON RESCUE BOATS**

2-159. Each rescue boat must be plainly marked as follows:

- Each side of each rescue boat bow must be marked in block capital letters and numbers with the name of the vessel and hull number.
- The number of persons for which the boat is equipped must be clearly marked, preferably on the bow, in permanent markings.

## **FIRST AID BURN TREATMENT**

2-160. This section contains information on the new federally authorized first aid burn dressing. Throughout this section the burn dressing will be called or referred to by its commercial name “Water-Jel”.

## **PLACEMENT**

2-161. First aid kits should be strategically placed upon the vessels in locations that would render them most effective in case of an emergency. Before placing kits into service, they must be inspected and inventoried. The inventory checklist will be posted on the outside of the kit annotating all items that have a specific shelf life, along with the expiration date of that item.. The kit must have an inventory conducted (at a minimum) annually.

2-162. Water-Jel is a unique multi-use product for emergency burn care and fire protection. This patented product is designed to help save lives, increase the relief of pain and suffering, and reduce tissue damage caused by burns. Water-Jel products have been adopted into the Federal Supply System by the Defense Medical Standardization Board and approved for sale by the U.S. Food and Drug Administration.

2-163. Water-Jel is a one-step system that combines a scientifically formulated gel and a special carrier material. The gel is biodegradable, bacteriostatic, and water soluble. Water-Jel can be carried anywhere. When placed on the burn victim, it extinguishes the flames and immediately lowers and stabilizes skin temperature, helping to ease the pain and calm the victim. Because the product is bacteriostatic, the covered wound is protected from further contamination. In addition to providing essential burn care, Water-Jel performs other lifesaving tasks. The product is water soluble, making removal of burnt clothing and jewelry easier. Water-Jel may also be used by a rescuer to shield himself and the victim from the intense heat and flames of a fire. In its larger sizes, Water-Jel may be used to extinguish a small fire and help provide a means of escape from larger fires. Water-Jel comes in a variety of sizes, from a 6-foot X 5-foot fire blanket to a 4-inch X 4-inch sterile burn dressing. The convenient packet or containers can be easily carried in all types of vessels and vehicles. They can also be stored in areas that are readily accessible to rescuers or burn victims.

2-164. The Burn Treatment Dressings, NSN 9515-01-518-8603, includes the following items listed in table 2-4 below and continuing on page 2-46.

**Table 2-4. Burn treatment dressing items**

<i><b>Dimensions</b></i>	<i><b>Type</b></i>
8" x 18"	Dressing

4" x 16"	Dressing
4" x 4"	Dressing
11" x 19"	Dressing

**Table 2-4. Burn treatment dressing items (continued)**

<i>Dimensions</i>	<i>Type</i>
12" x 16"	Dressing
Burn-Jel Kit	Topical Dressing
72" x 60"	Blankets

## TECHNICAL SPECIFICATIONS

2-165. The following describes the technical aspects of Water-Jel.

- Appearance- off white translucent.
- Odor- characteristic menthol.
- Environmental concerns- biodegradable.

## EXPIRATION DATES

2-166. Burn dressings sealed in a foil package expire three years from the date of manufacture. The manufacture date is part of the lot number stamped into the edge of the package. Burn blankets and wraps in containers expire five years from the date of manufacture. The manufacture date is part of the lot number located on a white sticker fastened to the container. Lot numbers read: DAY/MONTH/YEAR.

## FALL PROTECTION

2-167. The risks of sustaining injuries from falls are greater onboard Army watercraft. This section provides information on a number of control measures that are implemented to reduce those risks.

## FALL PROTECTION SYSTEMS

2-168. Fall protection systems can consist of devices that arrest a free fall or devices that restrain a Soldier in position to prevent a fall from occurring. A fall arrest system is employed when a Soldier is at risk of falling from an elevated position. A positioning system restrains the elevated Soldier, preventing him from getting into a hazardous position where a fall could occur, and also allows hands-free work. Both systems have three components: harnesses or belts, connection devices and tie-off points.

## HARNESSES AND BELTS

2-169. Full-body harnesses. This type of harness wraps around the waist, shoulders and legs. A D-ring located in the center of the back provides a connecting point for lanyards or other fall arrest connection devices. In the event of a fall, a full-body harness distributes the force of the impact throughout the trunk of the body—not just in the abdominal area. This allows the pelvis and shoulders to help absorb the shock, reducing the impact to the abdominal area.

2-170. Maximum force arrest on a full-body harness, which is used for the most severe free fall hazards, is 1800 pounds. Full-body harnesses come with optional side, front and shoulder D-rings. The side and front D-rings are connection points used for work positioning, and the shoulder D-rings are for retrieval from confined spaces.

2-171. Three factors determine the arresting force from a fall: lanyard material type, free fall distance and the weight of the soldiers. The use of a shock-absorbing lanyard or a higher tie-off point will reduce the impact force.

2-172. Belts. Belts are used in positioning system applications. These belts have two side D-rings, and are used only for restraining a soldiers in position. This type of belt is not used for any vertical free fall protection.

## **CONNECTION DEVICES**

2-173. Connection devices attach the belt or harness to the final tie-off point. This can be one device, such as a lanyard, or a combination of devices, such as lanyards, lifelines, work lines, rope grabs, tie-off straps and safety hooks.

## **LANYARDS**

2-174. Lanyards are used both to restrain soldiers in position, and to arrest falls. When using a lanyard as a restraining device, the length is kept as short as possible, as a restraining lanyard should not allow a Soldier to fall more than two feet. Restraining lanyards are available in a variety of materials, including steel cables; rebar chain assemblies and nylon rope. Fall protection lanyards can be made of steel, nylon rope, or nylon or Dacron webbing. Fall protection lanyards may also have a shock-absorbing feature built in, thus reducing the potential fall arrest force. Remember that maximum arrest force is 900 pounds for belts, or 1800 pounds for full-body harnesses. With a belt, the use of a shock-absorbing lanyard is recommended because it limits the arresting force from a six-foot drop to 830 pounds. If a shock-absorbing lanyard is not used, the tie-off point must be high enough to limit the arrest force to less than the 900-pound limit. The height of this tie-off point will vary, depending on the lanyard material and the weight of the person involved. A lanyard used for a fall is limited to allow a maximum six-foot free fall. For this reason, most lanyards are a maximum of six feet long. However, if a higher tie-off point is used, the lanyard can be longer if the free fall distance does not exceed 6 feet.

## **LIFELINES/SAFETY HOOKS**

2-175. Lifelines add versatility to the fall arrest system. When used in conjunction with rope grabs, a lifeline allows the soldiers to move along the length of the line rather than having to disconnect and find a new tie-off point. The rope grab is engineered to arrest a fall instantly. A rope grab and lifeline system is a passive form of protection, allowing the user to move as long as tension is slack on the lifeline. If a fall occurs, the tension on the rope grab triggers the internal mechanism to arrest the fall. Retractable lifelines automatically retract any slack line between the soldiers and the tie-off point. While this type of line doesn't require a rope grab, it must be kept directly above the soldiers to eliminate any potential swing hazard if the Soldier falls.

2-176. A cross-arm strap is used at a tie-off point with a large diameter, such as an I-beam, to which a lanyard or lifeline cannot directly attach. Using a cross-arm strap ensures the lanyard or lifeline doesn't become abraded from wrapping around the I-beam. A safety hook works in the same situations. It is used for tie-off points with a diameter of one to five inches, and then the lanyard is attached to the safety hook.

2-177. Tie-off Points. A tie-off point is where the lanyard or lifeline is attached to a structural support. This support must have a 5000-pound capacity for each soldiers tying off. Soldiers must always tie off at or above the D-ring point of the belt or harness. This ensures that the free fall is minimized, and that the lanyard doesn't interfere with personal movement. Soldiers must also tie off in a manner that ensures no lower level will be struck during a fall. To do this, add the height of the soldiers, the lanyard length, and an elongation factor of 3.5 feet. Using this formula, a six-foot tall soldier requires a tie-off point at least 15.5 feet above the next lower level.

2-178. Other Devices. For confined space applications, a tripod and winch system is used as both the tie-off point and connection device. It is used in conjunction with a full-body harness to lower and raise soldiers into tanks or manholes. Make sure that the tripod system you choose is designed for your application. Never use a material-handling device for personnel unless it is specifically designed to do so.

2-179. Ladder systems are lifelines attached directly to a ladder. The systems consist of a cable or channel, with a grabbing device attached for a connection point.

## **INSPECTION AND MAINTENANCE**

2-180. Regulations require that all fall arrest equipment be inspected prior to its use. This includes looking for frays or broken strands in lanyards, belts and lifelines, and oxidation or distortion of any metal connection devices. To properly maintain the devices, periodic cleaning is necessary. Clean all surfaces with a mild

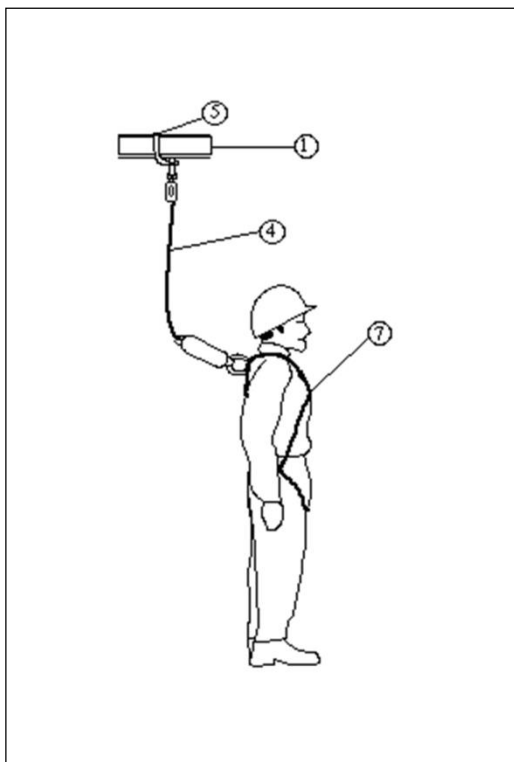


detergent soap, and always let the equipment air dry away from excess heat. Follow the manufacturer's instructions for cleaning and maintenance.

**Note.** ANY EQUIPMENT EXPOSED TO A FALL MUST BE TAKEN OUT OF SERVICE AND NOT USED AGAIN FOR FALL PROTECTION.

## COMPONENTS OF FALL PROTECTION SYSTEMS

2-181. Figures 2-19 through 2-22 on pages 2-48 through 2-50 show the components of fall protection systems.



1. Tie off point
2. Life line
3. Rope grab
4. Shock- absorbing lanyard
5. Cross-arm strap
6. Retractable lifeline
7. Full-body harness
8. Restraining belt
9. Restraining lanyard
10. Carabineer

**Figure 2-19. Components of the fall protection systems (1 of 4)**

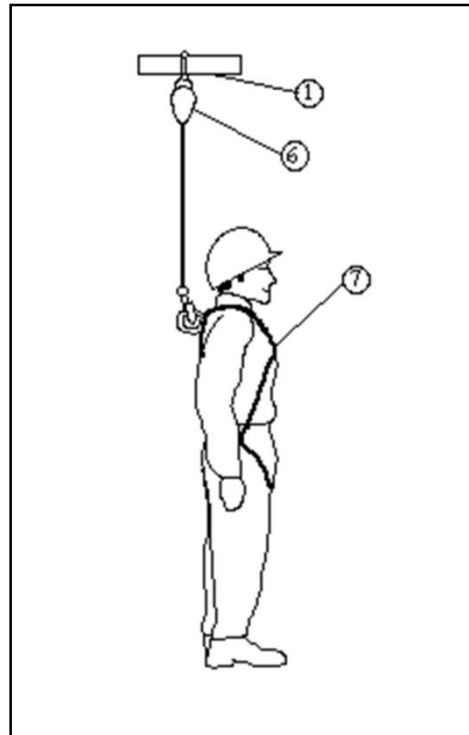


Figure 2-20. Components of fall protection systems (2 of 4)

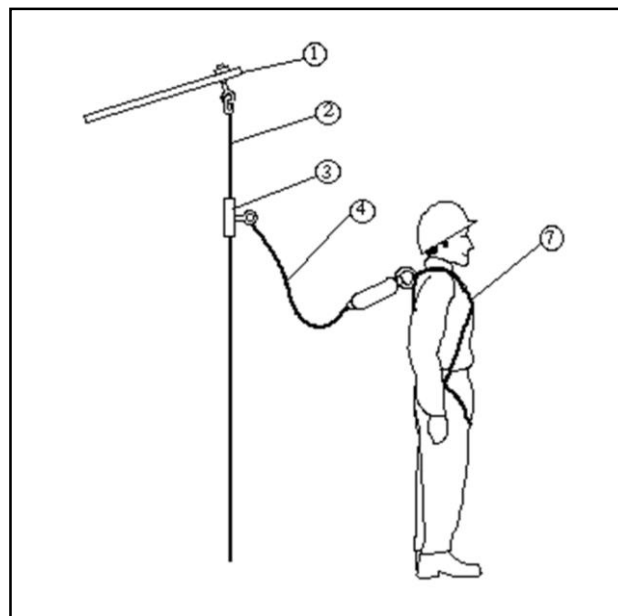
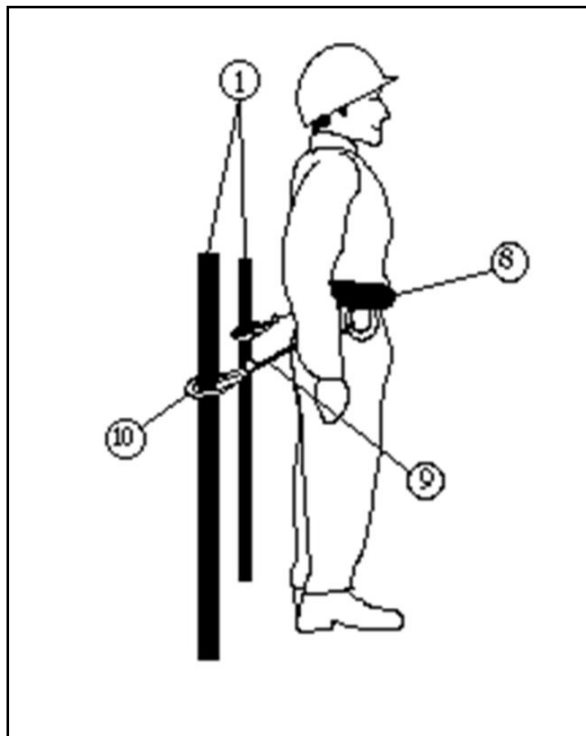


Figure 2-21. Components of fall protection systems (3 of 4)



**Figure 2-22. Components of fall protection systems (4 of 4)**

## HARD HATS

2-182. Hard hats are designed to provide protection to the head during exposures to potential hazards such as falling objects, striking against low hanging objects, or electrical hazards. Hard Hats will be worn during all cargo transfer operations, the unit commander or officer in charge of the operation can designate the “KEVLAR” helmet as a substitute for the hard hat. In general, protective helmets, or hard hats, should:

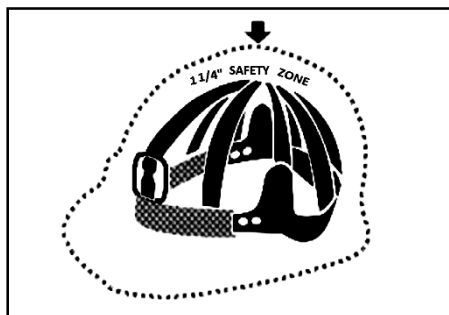
- Resist penetration by objects
- Absorb the shock of a blow
- Be water resistant and slow burning
- Be provided with instructions explaining proper adjustment and replacement of the suspension and headband

2-183. Hard hats require a hard outer shell and a shock-absorbing lining. The lining should incorporate a head band and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the user's head. This design provides shock absorption during impact and ventilation during wear. The basic design of the hard hat is shown in figure 2-23 on page 2-51.

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Note. The American National Standards Institute recommends replacement of hard hats after five years of service.

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**Figure 2-23. Hard hat basic design**

## INSPECTION

2-184. Head protection should be inspected prior to use and should be removed from service if the suspension system shows signs of deterioration such as:

- Cracking.
- Tearing.
- Fraying.
- The suspension system no longer holds the shell from 1 inch to 1 1/4 inches (2.54cm - 3.18cm) away from the wearer's head.

2-185. Inspect the outer surface and remove the hat from service if any of the following signs of deterioration are evident:

- The brim or shell is cracked, perforated, or deformed.
- The brim or shell shows signs of exposure to heat, chemicals, ultraviolet light, or other radiation. Such signs include:
  - Loss of surface gloss.
  - Chalking.
  - Flaking (This is a sign of advanced deterioration.).

## CARE NOTES

2-186. Paints, paint thinners, and some cleaning agents can weaken the shell of the hard hat and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats. Keep in mind that paint and stickers can also hide signs of deterioration in the hard hat shell. Limit their use.

2-187. Ultraviolet light and extreme heat, such as that generated by sunlight, can reduce the strength of the hard hats. Therefore hard hats should not be stored or transported on the rear-window shelves of automobiles or otherwise in direct sunlight.

2-188. To clean, immerse for one minute in hot (approximately 140° F, or 60° C) water and scrub using detergent. Rinse in clear, hot water.

## Chapter 3

# Firefighting

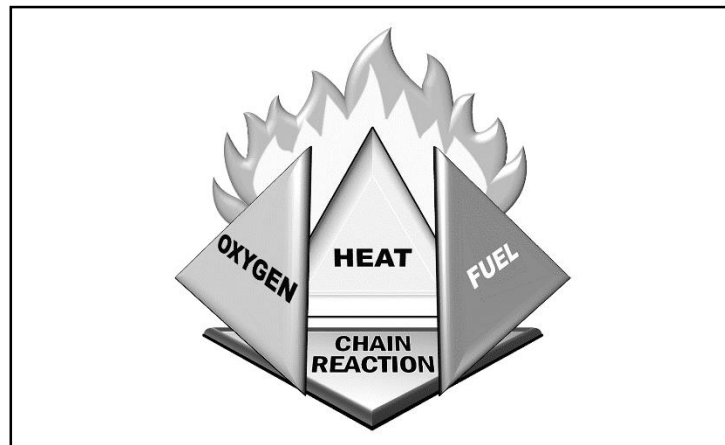
Firefighting is the use of strategy, personnel, equipment, and systems to extinguish fires. This chapter begins with explaining the chemistry of a fire and the theory of extinguishment, which aids in developing a firefighting strategy. Also discussed are the firefighting agents and systems specific to Army watercraft. The last part of this chapter describes personnel protection and firefighting equipment.

### CHEMISTRY OF FIRE

3-1. Matter exists in one of three states: solid, liquid, and gas (vapor). For a solid or liquid fuel to burn enough heat must be applied for vapors to form on the surface. These vapors must intermix with the oxygen in the surrounding air in order for a flammable mixture to form.

3-2. Fuel, oxygen, and heat are required for combustion. The fire triangle represents these requirements. The three sides of the fire triangle represent fuel, oxygen and heat. If any side of the triangle is missing, a fire cannot start. If any side of the fire triangle is removed the fire will go out. The ignition temperature of a substance is the lowest temperature at which sustained combustion will occur without the application of a spark or flame. The flashpoint is the lowest temperature at which a liquid gives off sufficient vapor to form an ignitable mixture. Sustained combustion takes place at a slightly higher temperature above flashpoint (referred to as the fire point of a liquid).

3-3. The fire tetrahedron (see figure 3-1) is a better representation of the combustion process. The four sides of the tetrahedron represent: fuel, oxygen, heat and the chain reaction. Combustion is sustained through a chemical chain reaction. Disrupting the chain reaction is a means of extinguishing a fire.



**Figure 3.1. Fire tetrahedron.**

3-4. Oxidation is a chemical process in which a substance combines with oxygen. Rusting iron/rotting wood are examples of slow oxidation. Fire (or combustion) is an example of rapid oxidation. During oxidation, energy is given off, usually in the form of flames. When a substance combines with oxygen at a very high rate, the energy given off as heat and light is so rapid that we can feel the heat and see the light in the form of flames.

3-5. Combustion is the rapid oxidation of millions of vapor molecules. During combustion, radiant heat is released, which radiates in all directions. Heat that radiates back to the fuel is called radiation feedback. The

radiation feedback creates more vapors from the fuel source. A self-sustaining reaction starts, burning vapor produces heat which releases and ignites more vapor. This chain reaction will continue as long as fuel, oxygen and sufficient heat are generated to create more vapors and raise the vapors to the fuels ignition temperature.

3-6. Heat transfer occurs through one or more of three different modes: Conduction, Radiation and Convection. Conduction is the transfer of heat through a solid body. Radiation is the transfer of heat across an intervening space; no material substances involved. Convection is the transfer of heat through the motion of circulating gases or liquids.

3-7. Flames and heat are obvious hazards of any fire, yet gases generated by combustion are also lethal. Carbon monoxide (CO) is an abundant byproduct of combustion, resulting from incomplete combustion. CO<sub>2</sub> is also an abundant byproduct, resulting from complete combustion. Both of these gasses can be harmful but carbon monoxide is a poison and the more dangerous of the two. The presence of byproduct gases reduces the oxygen content of the surrounding air, which is normally 21 percent. CO works on the respiratory system. Above normal CO concentrations in the air reduces the amount of oxygen that is absorbed in the lungs, impairing muscular control. Smoke generated by a fire creates an atmosphere that reduces visibility and impairs breathing.

## THEORY OF EXTINGUISHMENTS

3-8. A fire can be extinguished by the following methods:

- Removing the fuel. Removing the fuel source from a fire will extinguish the fire.
- Removing the oxygen. A fire can be extinguished by reducing the oxygen percentage in the air. Lowering the oxygen content in the air will decrease the intensity of the fire, eventually extinguishing the fire depending on the properties of the fuel. Fires can smolder in as low as 6% oxygen content.
- Removing the heat. Water, applied as a low velocity fog is the most effective means of removing heat from ordinary combustible material
- Break the chain reaction. A fire can be extinguished by disrupting the chemical process that sustains the fire.

3-9. For firefighting purposes, there are four classes of fire; class A, class B, class C, and class D.

- Class A fires involve wood and wood products, cloth, textiles and fibrous materials, paper and paper products and are extinguished with water. High velocity fog is the preferred method of extinguishing a class A fire.
- Class B fires involve gasoline, solvents, oil, and other flammable liquids. These fires are extinguished with Water fog, aqueous film forming foam (AFFF), FM 200, or CO<sub>2</sub>. Flammable gas fires should never be extinguished unless there is a reasonable certainty that the flow of gas can be secured. An explosive condition can result, which can be a greater hazard than the fire.
- Class C fires are energized electrical fires that are attacked using nonconductive agents such as CO<sub>2</sub> or FM 200 at prescribed distances. The most effective tactic is to de-energize and handle the fire as a class A or B fire.
- Class D fires involve combustible metals such as magnesium and titanium. Dry powders are the only agent used for extinguishing class D fires. DO NOT use water on a class D fire, water will increase the intensity of the fire and spread it. Do not confuse dry powder with dry chemical.

3-10. Table 3-1 below and continuing on page 3-3 shows the basic classes of fire, examples of the types of materials consumed and the types of agents used to extinguish the fires.

**Table 3-1. Fire classifications and extinguishing agents**

<b><i>Fire classification</i></b>	<b><i>Examples of types of materials</i></b>	<b><i>Type of extinguisher to be used</i></b>
Alpha	Wood, paper, cloth, upholstery	Water, and A, B, and C multipurpose dry chemical

**Table 3-1. Fire classifications and extinguishing agents (continued)**

<b>Fire Classification</b>	<b>Examples of types of materials</b>	<b>Type of extinguisher to be used</b>
Bravo	Flammable liquids, gasoline, jet fuel, paint, oil, grease	Aqueous Film Forming Foam (AFFF), A, B, and C multipurpose dry chemical, FM-200, Carbon Dioxide (CO <sub>2</sub> ), and water fog
Charlie	Electrical equipment and wiring	CO <sub>2</sub> , A, B, and C multipurpose dry chemical, and FM-200 are preferred but Purple Potassium (k) Powder (PKP) can also be used
Delta	Combustible metals, such as magnesium, titanium, zirconium, lithium, potassium, and sodium	Jettison from ship or extinguish with special dry powders based on sodium chloride or other salts; also clean dry sand can be used.

3-11. See appendix J for more detailed information on firefighting techniques.

## **FIREFIGHTING AGENTS**

3-12. The following paragraphs detail the various types of substances that are used as firefighting agents aboard Army watercraft.

### **WATER**

3-13. There are many materials that may be used as firefighting agents. Water is used primarily as a cooling agent. If the surface temperature of a fire can be lowered below the fuel's ignition point, the fire will be extinguished. A secondary method of water extinguishment is caused by steam smothering. Army watercrafts are equipped with the U.S. Navy's Shipboard Vari-Nozzle for this purpose.

### **FIRE HOSE NOZZLE**

3-14. The Vari-Nozzle is used on fire hoses and can deliver water in the form of a straight stream and high/low velocity fog patterns. The nozzle tip is rotated to deliver required firefighting stream patterns.

### **FOAM**

3-15. There are two basic types of foam: chemical and mechanical. Due to recent legal actions foam can only be utilized during real emergencies on board Army watercraft. Crew training using foam must be conducted in a controlled, land-based element following DOD policies and Environmental Protection Agency (EPA) standards. Foam is found on vessels that have manned machinery spaces, carry large capacity petroleum tanks, or tow fuel barges great distances. Foam is carried either in 5 gallon sealed plastic containers located in the manned machinery spaces or in large holding tanks. The shelf life of foam is 25 years however should the foam become contaminated or diluted then it must be replaced. Foam stored in tanks must be tested every 2 years while foam in 5 gallon plastic containers is serviceable until exposed to the elements. Army watercraft use the 6% concentrate foam in either gel or liquid form. Foams can be used on class A and B fires.

3-16. Chemical foam is formed by mixing an alkali (usually sodium bicarbonate) with an acid (usually aluminum sulfate) in water. Chemical foam has been phased out for shipboard use in favor of mechanical foam. Mechanical foam is produced by mixing foam concentrate with water to produce a foam solution. This foam solution is then mixed with air creating finished foam. The bubbles are formed by the turbulent mixing of air and the foam solution. AFFF provides three fire extinguishing advantages:

- An aqueous film is formed on the surface of the fuel which prevents the escape of hydrocarbon fuel vapors.
- The layer of foam effectively excludes oxygen from the fuel surface.
- The water content of the foam provides a cooling effect.

3-17. Limitations of foam:

- Electrically conductive and should not be used on live electrical equipment.

- Should not be used on combustible metal fires.
- Should not be used on fires involving gases.

## FIXED FIREFIGHTING SYSTEMS

3-18. The different types of firefighting systems used to combat fires aboard Army watercraft is discussed in this section.

### FM 200 / HEPTAFLUOROPROPANE (HFC-227EA)

3-19. FM 200 is the most common fixed firefighting system on Army watercraft. FM 200 is the brand name for heptafluoropropane (HFC-227EA). HydroFlouroCarbons (HFC) are composed of carbon, fluorine and hydrogen atoms. FM 200 extinguishes fire through heat absorption and to a lesser extent, chain breaking. The class of compound FM 200 belongs to are HFCs. HFCs are used in refrigeration and are a very effective heat transfer agent. HFCs remove heat energy from a fire so the fire cannot sustain itself. FM 200 also releases small amounts of free radicals upon exposure to flames. Free radicals inhibit the chain reaction responsible for combustion.

3-20. FM 200 will not damage delicate equipment because it does not have particulates or oily residues. It does not significantly reduce oxygen levels when deployed, making it safer for people. FM 200, when exposed to temperatures in excess of 1300 degrees F, will break down chemically and create hydrogen fluoride gas. This system must be recertified annually by a manufacture's certified technician. The bottles have a shelf life of twelve (12) years between hydrostatic testing unless they have been discharged.

#### WARNING

**HF gas is very toxic to humans. Concentrations above three (3) parts per million (PPM) can be harmful and/or fatal**

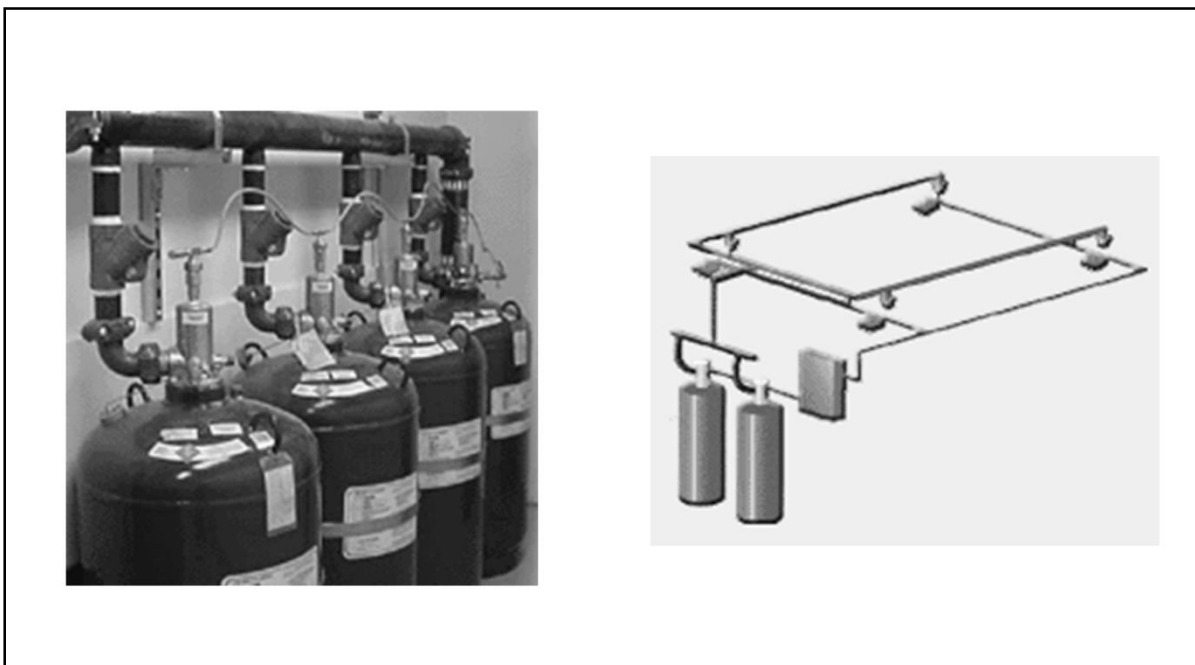
3-21. Benefits of using FM 200:

- Fast-acting FM 200 can stop fires in just seconds.
- Extinguishing fires quickly means less damage, repair costs and extra safety.
- FM 200 has been tested extensively to ensure safe exposure to humans.
- FM 200 does not leave oily residues, particulates, water, or corrosive material. This eliminates collateral damage to delicate equipment.
- FM 200 has a low environmental impact because it has a low atmospheric lifetime. It also has zero potential to deplete the ozone layer.
- Small space requirement compared to other fire suppression systems, such as CO<sub>2</sub> and inert gases require as much as seven times more storage space.
- Globally accepted FM 200 is the most widely accepted clean agent in the world. It is used in many fire suppression systems.

3-22. The systems are fixed, total flooding fire extinguishing systems (see figure 3-2 on page 3-5), with a general arrangement of actuation station, cylinder storage, alarms, and spaces protected by individual cylinder banks. Some exceptions are:

- The flammable liquid storage space.
- New systems to be installed for the Logistics Support Vessel (LSV) flammable liquid storage spaces.





**Figure 3-2. Hydro Fluoro Carbon (HFC)-227EA (FM 200) fire extinguishing systems**

### **WARNING**

**WHEN ALARM SOUNDS, VACATE AND SECURE THE SPACE TO KEEP THE FM-200 FROM ESCAPING OUT OF THE COMPARTMENT.**

3-23. The control cabinets or spaces containing valves or manifolds will be conspicuously identified in red letters at least 2 inches high. Example: “HFC-227EA or trade name (FM-200) FIRE APPARATUS.”

3-24. FM-200 systems utilize CO<sub>2</sub> gas to operate the time delay and alarm portion of the firefighting system. The time delay and alarms allow up to 60 seconds for individuals in the spaces to escape before the main extinguishing agent is discharged. However, there is sufficient CO<sub>2</sub> gas in the time delay and alarm operating system to cause breathing problems for anyone in the space when the devices are activated. Care needs to be taken to ensure that all individuals safely evacuate the space.

### **WATER WASHDOWN SYSTEM**

3-25. The water washdown system (WWS) can be utilized separately as a stand-alone system but it is integral to the FM 200 system. Only occupied machinery spaces have this system added to the FM 200 system. It is part of the fire main system but is activated at locations outside the space being energized. This system must be activated prior to activating the FM 200 system and must continue until a minimum of 15 minutes AFTER the FM 200 bottles are emptied. Its primary purpose is to ensure that the space temperature remains below 1300 degrees F in order to minimize the creation of HF gas. As a stand-alone system it can be energized repeatedly as a firefighting device.

### **CARBON DIOXIDE (CO<sub>2</sub>)**

3-26. The fixed CO<sub>2</sub> system is sized to the machinery space that it is designed to protect. It can be activated from one of two locations: locally at the bottles and external to the space being protected. This system must be recertified annually by a manufacture’s certified technician. The bottles have a shelf life of 12 years

between hydrostatic testing unless they have been discharged. Due to the oxygen displacement characteristics of this gas, there is a time delay of 60 seconds from the instant controls are activated until the actual gas is released. This time delay allows the space occupants to leave before the gas is released.

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**Note.** CO<sub>2</sub> is a dry, non-corrosive gas, which is inert when in contact with most substances, and will not leave a residue to damage machinery and electrical equipment. CO<sub>2</sub> has limited cooling capabilities. The firefighter should have backup extinguishers.

CO<sub>2</sub> extinguishes the fire by diluting and displacing its oxygen supply. Individuals employing CO<sub>2</sub> systems need to be aware of the dangerous situation caused by using CO<sub>2</sub> in closed spaces.

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## **GALLEY FIRE SUPPRESSION SYSTEM**

3-27. The galley fire suppression system is proven and reliable. It is always there, and will act as designed when needed. However, there are fundamental actions that can be accomplished that will prevent the need for its use. There are different types of systems on Army watercraft: fire suppression with nozzles and ventilation blocking which prevents the fire from spreading through the ventilation systems. These actions will help prevent a galley fire:

- Keep all galley equipment clean and free of grease buildup.
- Never use flammable solvents or cleaners on the galley equipment. Flammable residues could be left behind and could ignite during subsequent use of the galley equipment.
- Operate the galley exhaust system when the heat producing equipment is preheating, cooking, or cooling after use. This helps to prevent excessive heat buildup which could cause unnecessary system actuation.
- Never operate the hood without the filters in place. Excessive grease could build up in the hood and ductwork. Clean the filters regularly.
- Never restrict the air intake passages. This reduces the efficiency of the hood exhaust system and could lead to excessive heat buildup and accumulation of fumes.
- Properly operate the grease extractors to ensure effective grease removal from the hood and duct system.
- Never tamper with the fire suppression system components such as the heat detectors, nozzles, agent storage canister, cables, or the fusible links.
- Report any damage or suspect component to the Vessel Master and Chief Engineer or the Assistant Chief Engineer immediately.
- Ensure that portable fire extinguishers are properly placed, installed, inspected, and available for use.

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**Note.** U.S. Army vessels use a variety of galley equipment fire suppression systems. Care should be taken to reference vessel TM's and Manufacturer's documentation with regard to the specific system installed on board your assigned vessel. Maintenance and operation procedures will vary between systems and due care must be taken to ensure that proper procedures are followed for each system.

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3-28. Food service personnel must be trained in operation and maintenance of the galley fire suppression system on their assigned vessel.

## **REPORTING A FIRE**

3-29. The crew member who discovers the fire or the indication of fire must sound the alarm promptly.

**WARNING**

**THE FIRE SIGNAL IS A CONTINUOUS BLAST OF THE SHIP'S WHISTLE FOR NOT LESS THAN 10 SECONDS SUPPLEMENTED BY THE CONTINUOUS RINGING OF THE GENERAL ALARM BELLS FOR NOT LESS THAN 10 SECONDS.**

3-30. No crew member should ever attempt to fight a fire, however small it may seem, until the alarm has been passed to the bridge.

3-31. The crew member who sounds the alarm must be sure to give the exact location of the fire, what class of fire and as much information as is available when passing word to the bridge.

3-32. Before a compartment or bulkhead door is opened to check for fire, the door should be examined. Look for the following:

- Discolored or blistered paint indicates fire behind the door or smoke puffing from cracks at the door seal.
- The bulkhead or door should be checked for heat with the back of the hand, touching the door is not necessary to feel the heat.
- Once a hidden fire has been located, the door to the area should not be opened until directed by the On-scene leader. Cool the door with water, if necessary, before opening.
- Always open the door from a position clear of the opening and opposite the hinges.

## **FIRE DRILLS AND TRAINING**

3-33. The best organization and equipment is useless without trained personnel. Properly drilled crewmembers will lessen confusion during fires, increase the probability of proper initial actions taken against a fire, and enhance the predictability of firefighting responses and uses. Vital to the effort, however, is continuity of personnel. That is, people assigned to the firefighting party should retain that position even if other shipboard duties change. All members of a fire party should be cross trained for at least one other position on the fire party in order to provide frequent rotation. Ideally, everyone on the ship should be training to serve on a fire party since they may be needed to fight a major fire.

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*Note.* It is also important to use the drill as an opportunity to test, inspect, and repair all firefighting equipment. Each fire drill should have different locations and techniques from the previous drill. Do not use the same fire hose stations for each drill.

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## **REQUIRED FEATURES**

3-34. Effective fire drills do not happen automatically. Careless effort will result in useless drills which do not improve the crew's capability, or even bad drills which train poor habits. Each fire drill should include training elements which touch on all phases of firefighting. One example is training in combating a deep fat fryer fire. These drills will ensure personnel know how and when to secure the fryer and extinguish the fire. As a firefighting party improves, realism can be incorporated. One realistic means of insuring the crew knows initial reporting procedures is to use red rags and signs to indicate presence and class of a fire. When a crewmember discovers the fire they must report the simulated fire using proper procedures.

- Time compression is the most important feature to incorporate. A fire can grow from a tiny flicker to a life threatening blaze in a few minutes. Every delay in detection, notification, firefighting, and space isolation could cost a life or another burned out compartment. Drills must be practiced at real time speed. This creates two important conditions: the urgency of the situation and the inevitable problems with donning personal protection.
- Training in the use of the EEBD should be emphasized. Quickly donning the EEBD should be stressed as a way of saving time and improving the chances of survival when escaping a fire or smoke-filled space.
- The effects of smoke must also be included. These effects include the loss of visibility, loss of staging areas, loss of equipment in lockers which cannot be reached, and the extra confusion caused by all the above.
- Cascading casualties are also common in fires, as a fire spreads or damages vital services. Realistic, effective drills shall include these effects.
- Machinery space fires can grow out of control in seconds. For this reason, abandon the space evacuation drills should be conducted. Such drills should be focused on how to abandon the spaces quickly and safely.

### **CRITIQUE**

3-35. Critiques after every fire drill will help ensure that the maximum learning takes place. They should examine the underlying causes for successful or failed drills. They should include a thorough discussion of the rationale for each decision made on attack points, ventilation, and so on. This is the perfect time to review the results of firefighting equipment performance/accountability and plan any repair/procurement.

## **FIREFIGHTING SYSTEMS CAPABILITIES AND LIMITATIONS**

3-36. All ships are provided with one or more of the firefighting systems or equipment as described in the following paragraphs. Each has capabilities and limitations which shall be known and understood by firefighting personnel to ensure quick and proper selection of equipment. Fixed Gaseous Firefighting Systems are the primary firefighting agent for extinguishing class B fires in machinery spaces except for those cases where the fire can be extinguished by handheld equipment.

### **FIRE PUMPS (FIRE MAIN SYSTEM)**

3-37. Centrifugal fire pumps are installed for seawater supply to the fire main system. The fire main system will be kept intact so that water is available for cooling and the production of AFFF. Water is useful for cooling hot bulkheads in those spaces adjacent to the fire and extinguishing ordinary combustibles (class A) fires. When a hose line attack is needed to extinguish a flammable liquid fire and AFFF is not available, high velocity water fog may be used. However, time to fight the fire will be longer, more firefighters will be needed, increased fire damage can be expected, and a greater risk of re-flash will be present.

### **AQUEOUS FILM FORMING FOAM**

3-38. Aqueous film forming foam (AFFF) concentrate, when mixed with water, creates foam for application to surfaces. AFFF has a shelf life of 25 years when the storage container is not opened and exposed to contamination. It can be applied by a separate fire plug and hose with portable foam proportioned (inline eductor) It is effective on bilge fires to smother burning liquids, prevent large scale re-flash and for use during space reentry. When a hose line attack is made to extinguish a flammable liquid fire, AFFF shall be used unless expended or out of commission. In this event, use of water fog is acceptable.

### **REQUIRED CAPABILITIES**

3-39. The following is required of all systems:

- All systems are capable of total fire extinguishment and provide 15 minutes of re-flash protection.

- The systems will be designed to be acceptable for marine use, compatible with existing ships systems and working environments. The normal operating temperature range of the spaces protected will vary from 32 to 130 degrees F.
- All systems will be equipped with time delays and pre-discharged alarms based on personnel evacuation time or to prepare the hazard area for discharge. Also, time delays will have the capability to be manually bypassed (exception: time delays are not required for flammable liquid storage).
- All systems will be manually activated. Actuation will be accomplished by either mechanical or pneumatic means. Electrical actuation will not be allowed. Also, for those cylinders located within the space protected, automatic activation by a heat actuator will be provided.
- Natural and forced ventilation to the protected spaces will be secured prior to system activation. Automatic shutdown of powered ventilation and procedures for securing of natural ventilation prior to system activation will be required.
- All internal combustion engines located in protected spaces, which draw intake air from within the protected spaces, will be equipped with shutdown devices which are automatically actuated in the event of the fire extinguishing system activation. All internal combustion engines located in protected spaces, which draw intake air from outside the protected spaces, will be equipped with shutdown devices which are manually actuated in the event of the fire extinguishing system activation.
- All agent storage cylinders will be securely supported and rigidly fastened and be equipped with pressure gauges and magnetic liquid level indicators.
- System designs will be based on watercraft being fully operational, as opposed to cold iron. Maintenance and training requirements will include winterization, lay-up, and re-activation procedures.
- System installation will permit normal operations required in walking and working areas without undue interferences, clear headroom of 6 feet 3 inches is required in all walking and working spaces.

3-40. System details. Design concentration, total flooding quantity, and discharge rate for fire extinguishing agent are based on the minimum amount of agent concentration supplied by each system for fire extinguishment and on cup burner extinguishment concentration plus a 40 percent safety factor at 20 degrees Celsius (68 degrees Fahrenheit). In no case will the design concentration exceed the lowest observed adverse effect level of 10.5 percent at the highest ambient temperature expected in the hazard areas at 54 degrees Celsius (130 degrees Fahrenheit).

3-41. The total flooding quantity required will be calculated in accordance with National Fire Protection Association (NFPA) 2001, Section 3-5.

## **FIREFIGHTING SYSTEMS SPECIFIC TO ARMY WATERCRAFT**

3-42. The following sections provide information on firefighting systems that are specific to Army watercraft.

### **ALARMS**

3-43. Alarms are used to alert and warn personnel to the dangers of a fire. There are three types of alarms used on Army watercraft; audible, visual and time delay.

#### **Audible Alarms**

3-44. All protected spaces will be equipped with pre-discharge alarms (audible and visual). The alarms will be conspicuously marked. The audible alarm will sound for the required duration prior to release of the agent into the space. The audible alarm will be sirens powered only by the agent released. Also install an electric alarm bell outside each protected space. The bell will be activated by means of a pressure switch actuated by the release of agent. This alarm bell will sound continuously until manually reset. The alarm bells will be powered by the watercraft's emergency power source. This is to warn the ship's personnel that the system

has been deployed. For engine room spaces, the sirens must be audible above the sounds of operating machinery and be audible in the control room (where applicable), as well as in the machinery space.

### **Visual**

3-45. All protected spaces will be equipped with visual alarms. The visual alarms will be an amber strobe light activated by means of a pressure switch actuated by the release of agent. Multiple spaces protected within a compartment will require a strobe light for each space. Lights will be powered by the watercraft's emergency power source. Paint lockers are not required to have visual alarms.

### **Time Delays**

3-46. All systems will be fitted with an approved time delay so that the alarms will operate before the agent is released into the space. Also, time delays will have the capability to be manually by-passed. Paint lockers are not required to have time delays. Time delay bottles contain CO<sub>2</sub> gas when released, the amount of CO<sub>2</sub> that is released is sufficient enough to cause unconsciousness and death to all individuals within the space.

### **CONTROLS AND VALVES**

3-47. Where necessary, excessively tight compartments such as small paint lockers will be provided with suitable means for relieving excessive pressure accumulating within the compartment when the agent is released and allowing for proper agent progressive mixing within the protected space atmosphere. Controls and valves for operation of the system will not be located in any space that might be cut off due to a fire in any space protected (exception: paint lockers). Some suitable means are as follows:

- Manual and automatic actuation control stations.
- Remote and automatic shutdown devices.
- Audible and visual activation alarms.

3-48. Two independent manual actuation control stations are to be provided, one of them being positioned at the cylinder storage location and the other in a readily accessible position as convenient as practical to the main escape from the space. Also, for standardization, provide a third remote manual actuation station outside on the main deck for the main propulsion engine rooms, as presently located on the majority of watercraft. These actuations control stations will be mounted in one corrosion-resistant watertight enclosure, capable of withstanding heavy sea conditions and will be quick-acting to open. Placard directions will be mounted on the inside cover.

3-49. Systems will be actuated from the actuation stations by two control levers. One control lever operates the stop valve to the space and the other control lever is a separate control that releases the agent. These controls will be in individual pull boxes clearly identified for the particular space. Actuation stations will be conspicuously mounted to facilitate operation in an emergency. Actuation stations will be standardized (same manufacturers) throughout the fleet (exception: paint lockers will be actuated by one control level releasing the agent (break glass, pull lever).

3-50. All systems will be manually controlled. For systems where the cylinders are stored within the protected space, the system will be fitted with an automatic heat actuator device. This device, in the event of an undetected fire in the protected space, will allow the system to safely release the contents of the cylinders into the protected space. These spaces will also have two independent manual-operated releases as previously specified.

### **MARKINGS FOR FIRE AND EMERGENCY EQUIPMENT**

3-51. All system warning placards will be of the phenolic (plastic molded) type. Markings will be permanently attached, displaying 1/2 inch red lettering on a white background. System piping will be marked in accordance with TB 43-0144. The distribution line valves of all extinguishing systems will be plainly and permanently marked indicating the spaces served. Complete and simple instructions for operation of system will be posted in a conspicuous place at or near the pull boxes, stop valve controls, and in the cylinder storage rooms. Systems where cylinders are stored outside of the protected space will include a schematic of the

system and instructions for alternate method of discharge should the manual release or stop valve fail. The discharge and pre-discharge alarms will be conspicuously identified in red letters at least 2 inches high.

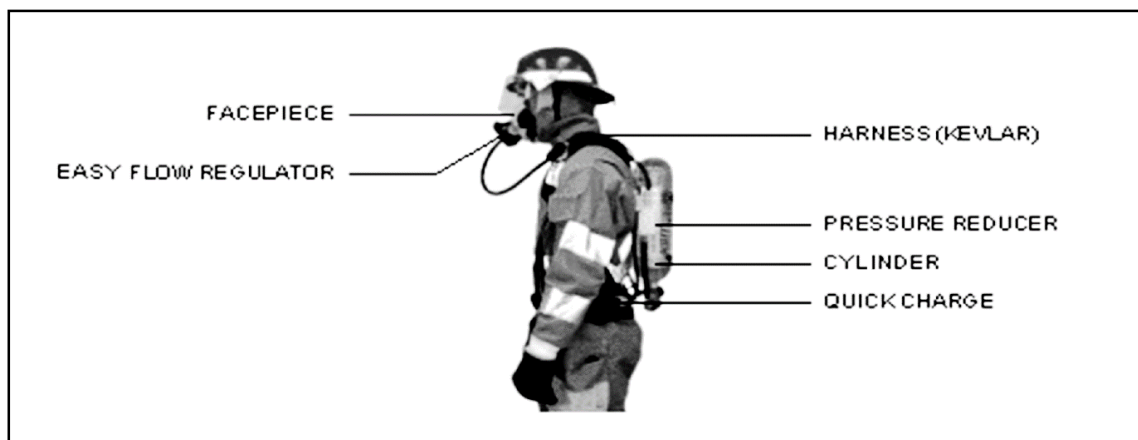
## PERSONNEL PROTECTION AND FIREFIGHTING EQUIPMENT

3-52. The proper use of personnel protection and firefighting equipment is required to reduce the risk of injury and facilitate extinguishing the fire. Some general considerations for those individuals who enter the space are the following.

- Self-Contained Breathing Apparatus (SCBA), with voice amplifier if on ship's allowance list, should be worn by all personnel within buffer zone or when entering the affected space until the atmosphere is declared safe. When smoke is present, Breathing Apparatus activation should be ordered and reported to the officer in charge.
- Clothing. Fire fighters ensembles shall be appropriately pre-positioned to be readily available to fire party personnel when the fire party is called away. Personnel required to wear the firefighter ensemble are the scene leader, nozzle men, and hose men. Support personnel such as phone talkers, plug men, electricians, and medical personnel, outside the fire boundary, shall wear duty uniforms, anti-flash hoods, and gloves.
- Hoses. As a minimum, a single attack 1 1/2-inch saltwater hose shall be used by the reentry team. The hose and nozzle provide added protection for the nozzle-man and hose tenders. Before the single attack hose enters the space, a second backup attack saltwater hose should be manned and charged to render assistance. When assigned by the scene leader, each hose team will be led by an attack team leader. Sufficient distance shall be maintained between the first and second hoses to prevent maneuverability and firefighting progress from being impaired. Inasmuch as reentering the space may be a lengthy and awkward process, saltwater hoses should therefore be used to cool access doors, hatches, and scuttles. Saltwater hoses should not enter the space where it will impair the effectiveness of the AFFF hose teams. To conserve AFFF, hoses equipped with inline eductors can discharge saltwater if pickup tubes are removed from AFFF 5-gallon cans. The eductor will continue to function with reinsertion of the pickup tube into the AFFF containers.

### SELF-CONTAINED BREATHING APPARATUS

3-53. The Self-Contained Breathing Apparatus (SCBA) provides the firefighter with air for breathing while in a fire or another hazardous environment (see figure 3-3). It consists of a composite or metal cylinder for high pressure (4,500 pounds per square inch (PSI)) air storage and regulators to reduce air pressure to useable levels. Air is provided to the user at above ambient pressure to provide a positive pressure in the face piece and prevent hazardous gases from entering. Changing out the SCBA cylinder is required to replenish air supply.



**Figure 3-3. Self-contained breathing apparatus (SCBA)**

3-54. To determine which size is best for you do the following:

- Starting with a large face piece, extend the straps, place your chin in the chin cup and pull the straps over your head.
- Tighten the top straps first and then the lower or chin straps. Ensure that the “figure 8” in the middle of the straps is centered on the crown of your head.
- Place the palm of your hand over the opening in the front of the face piece where the regulator installs. Inhale and listen/feel for leaks. The mask should collapse against your face. If the mask leaks, try tightening the straps.
- If this does not help or causes discomfort then you may need to try the small mask. If the mask feels too small on your face then you might try the extra-large face piece.
- Repeat the leak check in each case.

### **Self-Contained Breathing Apparatus Specifications**

- Cylinder:
  - Holds 4500 psi compressed air.
  - Fully wrapped composite construction.
  - Breathing quality air (Grade D) not oxygen.
  - Only durations of 30 and 45 minutes.
  - Stored in lockers throughout ship on SCBA backpack and as spares.
  - 15 year service life, requires a function test every three years and hydrostatic testing every five years.
  - Label contains manufacturer’s name, date of manufacture, hydrostatic test information and DOT exemption number.
- Valve:
  - Located at neck of cylinder.
  - Depress bottle valve handle and rotate to open and then back off ¼ turn.
  - Connection: CGA-347 (standard for breathing air in the pressure range of 3000-5000 psi).
  - Burst disc: actuates when pressure inside air cylinder reaches about 7200 psi.
- Pressure Indicator:
  - Located on valve assembly at neck of cylinder.
  - Provides continuous indication of air cylinder pressure
  - Does not require calibration (shall not have “No Calibration Required” sticker)
- Cylinder Hang Plate:
  - Located on valve assembly at neck of cylinder.
  - Provides mechanism for securing air cylinder to SCBA backpack.
- Backpack:
  - Corrosion resistant wire frame and cylinder hook (mates to cylinder hang plate).
- Cylinder Band and Latch Assembly:
  - Adjustable band and latch that secures air cylinder to backpack.
  - Fine adjustment can be made using vernier adjustment while toggle lever is open (proper adjustment = not able to turn with finger pressure when latched).
- Harness Assembly:
  - Consists of two adjustable shoulder straps and an adjustable waist strap with pads.
  - Waist belt has quick-release buckle and adjusters and houses holder for second stage regulator.
  - Shoulder straps have pull up, push-to-release adjusters for quick adjustment.
  - Flame and heat resistant Kevlar.
- Remote Pressure Indicator:



- Located in front on right side shoulder strap.
- When air cylinder valve is open, provides continuous remote indication of air cylinder pressure.
- Face is fully luminescent.
- Does not require calibration (shall not have “No Calibration Required” sticker).
- High Pressure Hose:
  - Located between cylinder valve and First-Stage regulator (“pressure reducer”).
  - Delivers air at cylinder pressure to the First-Stage regulator.
  - Hose is attached to air cylinder valve by the coupling nut. The high pressure seal is made by the coupling nut O-ring. Before disconnecting the coupling nut, ensure all air is bled from the high pressure hose. Air left in the hose may cause the O-ring to dislodge, resulting in inability to make a seal.
- First-Stage Regulator:
  - Mounted to the left of the air cylinder.
  - Reduces cylinder pressure to about 100 psi.
  - Uses a redundant dual path reducing system; secondary path automatically supplies air if primary path fails.
- Pressure Relief Valve:
  - Located on the side of the First-Stage regulator.
  - Reseatable relief valve; actuates above 185 pounds per square inch (psi).
- Quick Charge Assembly:
  - Located adjacent to the waist strap on the left side of the wearer.
  - Air cylinder refillable without removing the air cylinder and while continuing to breathe on the SCBA.

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**Note.** The quick charge assembly should be stowed below the waist belt at all times.

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- Low Pressure Hose:
  - Located between pressure reducer and second stage regulator.
  - Provides pressure of ~100 pounds per square inch gauge to second stage regulator.
- Regulator:
  - Located at the end of the low pressure hose and connects to the face piece.
  - Demand regulator maintains a positive pressure in the face piece at all times.
  - If face piece or seal is broken, air will flow freely from regulator.
- Purge Valve:
  - Red knob located on the left side of regulator (as viewed when wearing).
  - Purge valve manually overrides the Second-Stage regulator.
  - Provides a constant flow of air to the face piece.
  - Used for emergencies only; exit space immediately if breathing with purge valve.
  - Can also be used to clear fogging in face piece.
  - Rotate handle (away from wearer) to open.
- Air Saver Switch:
  - Black button on top of regulator.
  - Stops air flow from the Second-Stage regulator.
  - Press and release to actuate.
  - Inhale sharply to disengage.

- Removal Lever:
  - Black tab on right side of regulator.
  - Used to “unlock” Second-Stage regulator from face piece in order to remove it.
  - To use, push tab away face and hold while turning.
- “Vibralert” Alarm Assembly:
  - Housed within the Second-Stage regulator.
  - Alarm will sound when 20-25% of cylinder air remains.
  - Alarm will also activate to indicate a problem in the First-Stage regulator.
- Face Seal:
  - Available in three sizes: small (green), large (black), and Xlarge (red).
  - Made of a blend of natural and synthetic rubber.
  - The Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA) both require a fit test conducted by all persons that might be called upon to wear SCBA.
- Lens:
  - Single, replaceable, wide angle, clear lens.
  - Made of polycarbonate with a silicone-based coating to resist abrasion and chemical, biological, radiological, and nuclear attack.
- Head Harness:
  - Connected to the face piece by quick adjusting buckles and snap retainers.
  - Made of synthetic rubber.
- Voice Amplifier:
  - Located in a mounting bracket over the right side voicemitter.
  - Powered by one 9-volt battery.

### **SCBA Donning Procedure**

3-55. Perform a quick visual inspection for any obvious damage that would preclude safe and proper use of the SCBA. Check the following parts for damage:

- Face piece: rubber deterioration, cracks, tears, holes, and tackiness.
- Head Harness: breaks; missing straps; loss of elasticity; buckles deformed, corroded, damaged or missing; strap serrations worn.
- Lens: cracks, scratches, loss of tightness to face piece, regulator inlet coupling deformed or damaged.
- Backpack: cuts, tears, abrasions, signs of chemical or heat damage, inoperative buckles, damage to wire frame.
- Cylinder: minimum pressure allowed is 4000 psi; check cylinder for charring, dents, gouges or cuts that may have penetrated fiberglass or carbon fiber.
- Hoses: cuts, cracks, abrasions, bulges, wrinkles, loose fitting or inoperative connections.
- EZ-Flow Regulator: Check casing for damage, dirt or debris. Actuate purge valve, air saver switch and removal lever. Check sealing gasket.

3-56. Don SCBA (coat method or over-the head):

- Most of the weight (85%) should be carried on the waist/hips.
- Check all straps for correct adjustment.

3-57. Don Face Piece:

- Spread face piece straps from inside with thumbs.
- Place chin in chin cup.
- Pull harness over your head and smooth straps.

- Ensure all hair is away from seal.
  - Tighten neck straps first, then temple straps.
- 3-58. Perform negative pressure check:
- Place hand over face piece opening for second stage regulator.
  - Inhale and hold your breath.
  - Listen/feel for inward air leakage.
  - Adjust face piece as needed until seal is maintained.
- 3-59. Open air cylinder valve:
- First depress air saver switch.
  - Ensure purge valve is closed.
  - Open cylinder valve, close 1/4 turn, and listen for Vibralert to sound during initial equalization.
  - Verify remote pressure indicator is reading within 500 psi of the cylinder pressure.
- 3-60. To begin operation (“go on air”):
- Attach Second-Stage regulator to face piece lock in place.
  - Inhale sharply to begin flow of air.
  - Breathe with purge valve open to experience breathing in free flowing air.
  - Close the purge valve, press air saver switch and disconnect regulator from face piece.
  - Wait to engage the air saver switch until just prior to pulling the regulator away from the mask.
- 3-61. Refer to specific manual instructions for detailed guidelines.

## Tending Line

3-62. When the SCBA is in use, a tending line is provided for the user as a precautionary measure. The SCBA tending line is a 50-foot length of 3/16 inch aircraft cable with a clear plastic covering. The tending line has a stout hook at each end, which is closed with a snap catch. Either hook is used for attaching the line to the D-ring on the SCBA body harness pad. The cable is pliable and will slide freely around obstructions.

### *Use of Tending Line*

3-63. When there is only one SCBA wearer in a compartment, a tending line will be used and there will be at least one additional person handling the line. The tending line is used to locate an injured person wearing the SCBA. To locate the injured person, follow the tending line to their location. Personnel tending the line should wear rubber gloves and boots. If there are two or more SCBA wearers in the same compartment, it is not necessary to use a tending line. SCBA wearers should keep in constant touch or sight of each other.

## WARNING

**If at all possible, stricken personnel will not be hauled by a line attached to their waist, or suspended from their waist. This can cause internal injuries. In an emergency situation, they may be dragged a short distance along the deck if no other means of rescue is possible. If the person lacks any sort of shoulder harness, make fast a line under their arms. Have the line meet either in front or in back.**

3-64. Do not attempt to pull injured personnel out using the tending line. This may injure them even more, as well as costing valuable time. For a rescue to be effected immediately, rescue personnel standing by will have SCBAs donned and in the standby position. This will enable immediate entry when cylinders are fired.

### *Tending Line Signals*

3-65. When a tending line is employed, the wearer of the SCBA will remain in constant contact with the line tender. This is accomplished by the tending line signal system. Table 3-2 shows the code, number of pulls and the corresponding meaning. The code for the signals spells OATH. This makes it simple to remember the signal system.

**Table 3-2. Tending Line Signals**

<b>Code</b>	<b>Pull</b>	<b>Meaning</b>
O	1	Okay
A	2	Advance
T	3	Take up
H	4	Help

#### **WARNING**

**Four or more pulls indicate that the wearer is in need of help.**

### **Stowage**

3-66. Stowage in Lockers. Stow SCBAs in damage control lockers or in specified SCBA lockers located throughout the ship. Stow SCBAs in cool and dry areas of the damage control lockers. This prevents the build-up of moisture, which causes mildew damage to the rubber face piece, inhalation and exhalation tubes, and breathing bags. Keep all SCBAs away from oil, paint, and greasy substances. These are harmful to materials used in the construction of the SCBA. A properly stowed SCBA in a damage control locker is laying horizontal, one high, on a shelf with the face piece on top. A SCBA may be hung only in specific SCBA lockers.

3-67. Stowage in Kit Bags. SCBAs may be stored in the Firemen's Kit Bag along with anti-flash hood, anti-flash gloves, firefighting helmet, and firefighting gloves. The kit bags may be hung on hooks which should be installed in such a way that the bags will be out of traffic and will be easily accessible. Care must be taken that the heavy body of the SCBA and other heavy items are placed in the bottom of the bag and the mask is placed on top to avoid damage to breathing tubes.

3-68. Protection of Face piece. The face piece may become scratched and damaged from entering and leaving tight spaces, while the mask is in the standby position. Damage may also occur from stowing and moving the SCBAs. To prevent damage and the need to replace the face piece, place the anti-flash hood over the entire face piece down to the bottom of the breathing tubes.

### **CLOTHING/FIREFIGHTER ENSEMBLE**

#### **WARNING**

**The ensemble does not offer protection against chemical, biological, or radiological effects. The firefighter ensemble is intended to protect the firefighter from flame (flash) exposure, heat, and falling debris.**

3-69. The fire fighter ensemble consists of the following:

- Fire fighter's coveralls.
- Anti-flash hood.

- Anti-flash gloves.
- Damage control/firefighter's helmet.
- Fire fighter's gloves.
- Firemen's boots.
- Stowage bag.
- Flashlight, explosion proof.
- Self-Contained Breathing Apparatus (SCBA).

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Note: The National Fire Protection Association recommends that all firefighting suits be replaced after five to seven years

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### **Firefighter's Coverall**

3-70. The firefighter's coverall design is a one piece, jump suit style (figure 3-4 on page 3-18). The coverall has a tough outer shell, a vapor barrier, and an inner fire retardant thermal liner. The knees, bottoms of the thigh pockets, and bottoms of the legs are reinforced with leather padding for extra protection. As an additional safety feature, the coverall has reflective markings around the upper arms, lower legs, and torso to highlight the outline of the firefighter, so he can be seen in dense smoke or dim light. The front closure and inside lower legs have brass zippers. There are bellow pockets with Hook-and-loop closures on the outside of each thigh and on the front of the upper left arm. The coveralls have a corduroy faced collar with snap fasteners. The sleeves have an integral knit wristlet for wrist protection and small loops (thumb holes) on the ends of the sleeve wristlets to insert your thumbs to anchor and keep the sleeve from riding up the arm. The coveralls are available in five sizes (small through extra-large-tall).

### **Firefighter's Anti-Flash Hood**

3-71. The firefighter's anti-flash hood (figure 3-5 on page 3-18) provides protection to the head, neck, and face (except the eyes). The hood can be worn with the SCBA. It has an elastic face closure and is available in a single size which fits all. The face portion can be pulled up over the nose for additional protection of the face.

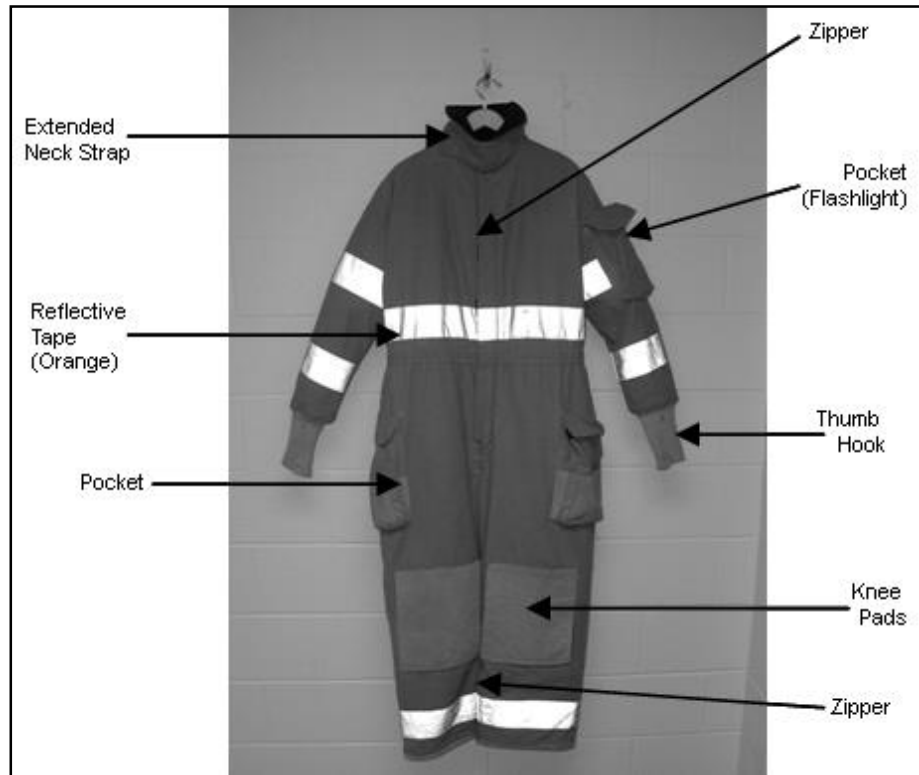


Figure 3-4. Firefighter's coverall

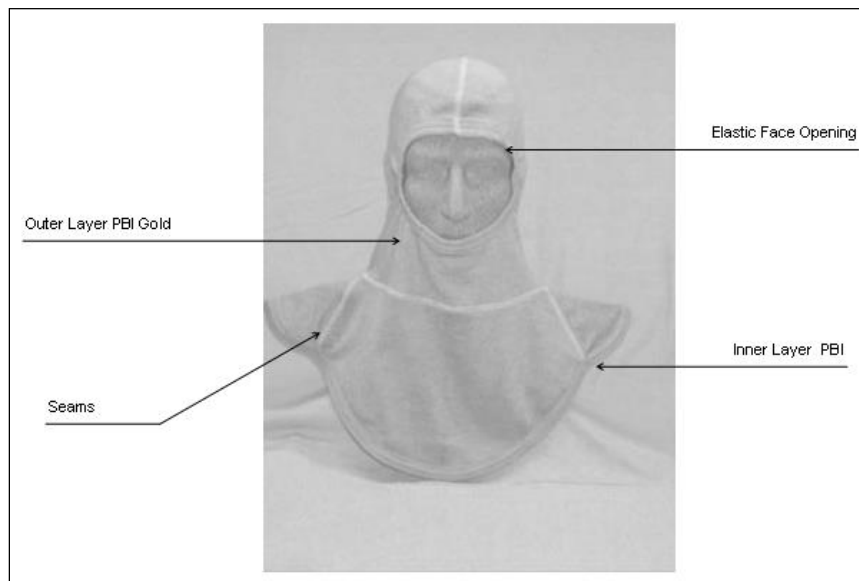


Figure 3-5. Flash hood

### Anti-Flash Gloves

3-72. Anti-flash gloves are depicted in figure 3-6 on page 3-19. The use of the gloves is to protect personnel from elevated air temperatures resulting in burns caused by fire. The gloves are made from fire retardant cotton and one size fits all.



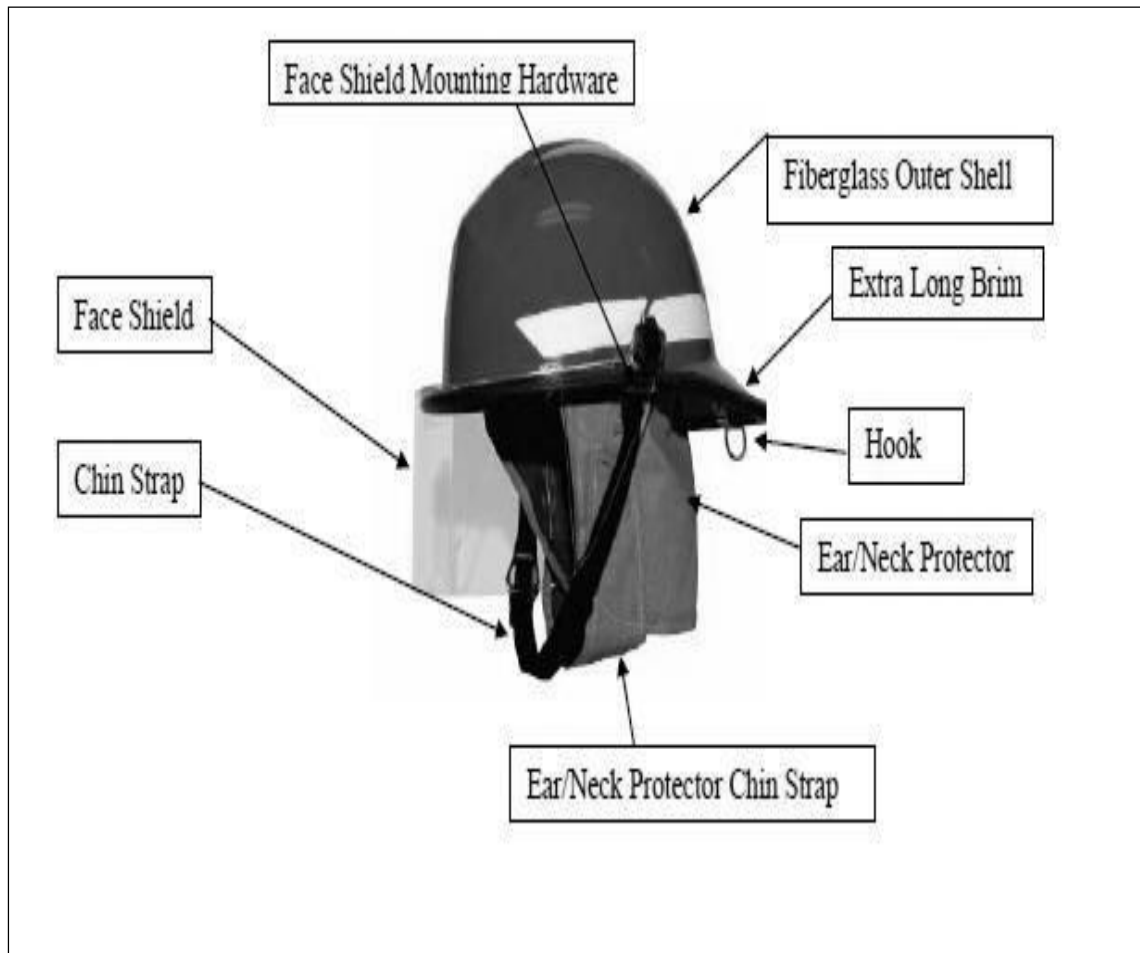
**Figure 3-6. Anti-flash gloves**

### **Damage Control/Firefighter's Helmet**

3-73. The helmet (figure 3-7 on page 3-20) is designed to protect the head, neck, and face from flame (flash) exposure, heat, and falling objects. The helmet shell material is heat resistant fiberglass and is provided with a face shield, chin strap, adjustable suspension, reflective markings, and a liner that covers the side of the head and neck.

#### **CAUTION**

Do not modify the helmet in any manner, including removing the face shield and drilling holes to attach a light. Modification will reduce the protection provided by the helmet.

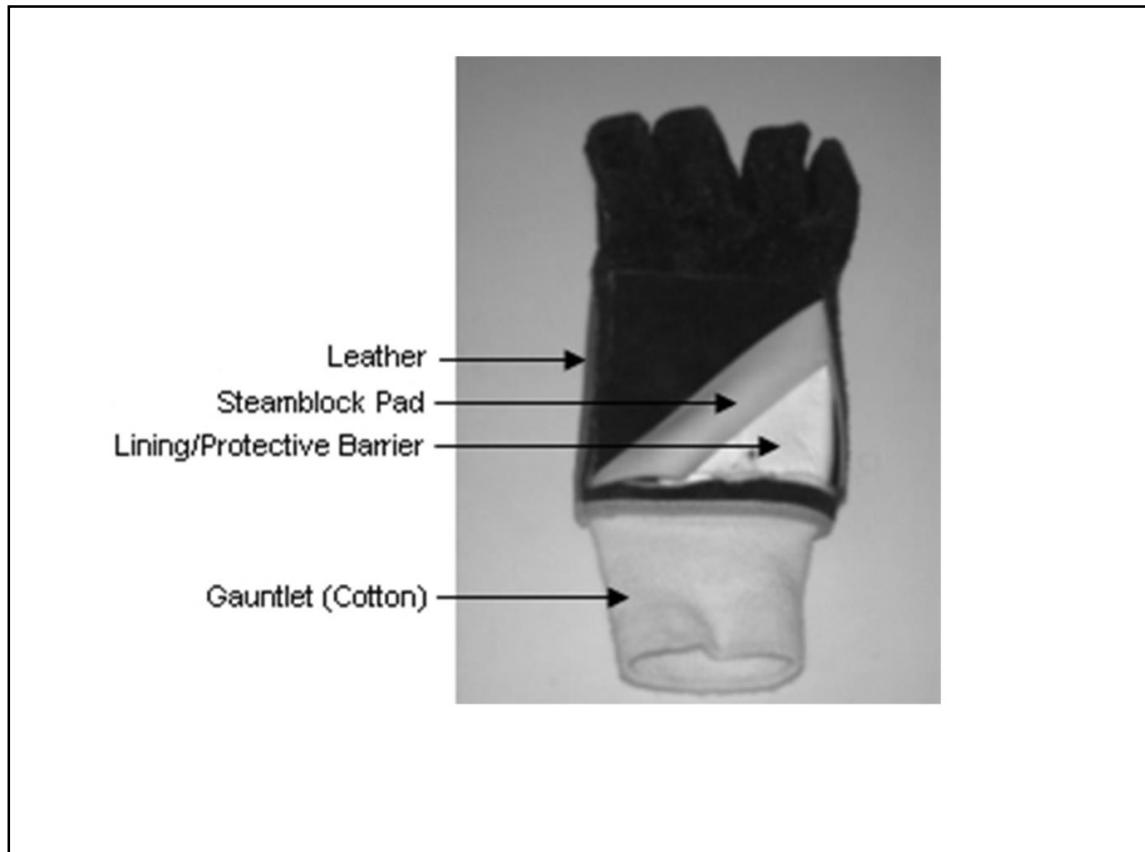


**Figure 3-7. Firefighter's helmet**

### **Firefighter's Gloves**

3-74. The firefighter gloves (Figure 3-8 on page 3-21) protect against abrasions, short duration flame (flash) exposure, and heat. The five-finger cut, gauntlet gloves are fabricated from leather and have a waterproof vapor barrier and fire retardant liner. The gauntlet provides wrist protection. The gloves are available in five sizes (extra small through extra-large).





**Figure 3-8. Firefighter's gloves**

### **Fireman's Boots**

3-75. The rubber boots (figure 3-9 on page 3-22) have steel safety toes and puncture proof steel insoles. Fireman's boots are available in two models, knee high and hip length. The U.S. Army currently is using the knee high version. Knee high boots are worn inside the coveralls and are available in sizes 5 through 15.



**Figure 3-9. Fireman's boots**

### **Stowage (Kit) Bag**

3-76. The stowage bag is provided to preassemble the ensemble for stowage. This bag is constructed of canvas duck with carrying straps. In emergency situations, after removing the ensemble from the bag, the stowage bag can be used for transporting other damage control equipment to the scene. In particular, the bag can be used to move spare SCBA's and cylinders.

### **INSPECTION CRITERIA**

3-77. During emergency fire drills, inspect each piece of equipment prior to restowing. There should be no rips, tears, or holes in any gloves, coveralls, or hoods. Helmet should not be cracked or have any missing components. Helmet face shield should allow clear visibility by not being damaged with scratches. Zippers of coveralls should not be corroded by any exposure to the elements. Boots should not have any cracks or split seams on the soles and sides. Explosion proof flashlights should have batteries removed and stored in clear plastic sealable bag for future use. All components should be clean and dried before being restowed.

### **DONNING AND ADJUSTING**

3-78. An integral part of the firefighting ensemble is the type A-4 self-contained breathing apparatus (SCBA). The following steps will instruct the user on how to don and adjust the firefighting ensemble including the SCBA.

- The SCBA is stowed with an anti-flash hood protecting the face piece lens. Remove the anti-flash hood from the SCBA face piece lens ring and put the hood over the face.
- Keep your pants and shirts on. Remove your shoes or boots and remove anything else that will interfere with donning the coverall, such as items in pockets.

- Put on the coveralls and pull them up and over your shoulders.
- Insert thumbs through the small loops on the ends of the sleeve wristlets to anchor and keep the sleeves over the wrists and under the gloves.
- Step into the fireman's boots. Never put on the boots before you put on the coveralls.
- Secure the two zippers on the bottom of the coverall legs.
- Stand up the coverall collar and ensure the anti-flash hood is fully inside the collar and down the chest as far as possible.
- Close the coverall front body zipper and the two collar snaps.
- Don the SCBA. Do not secure the face piece.
- Pull the anti-flash hood face opening down around your neck.
- Put on the SCBA face piece, tighten straps, and check for face piece straps, with the elastic opening over your face. Secure the hook-and-loop-closure on the coverall collar.
- Put the helmet on, secure helmet liner flap hook-and-loop-fastener, and fasten the chin strap.
- Loosen face shield fasteners on the sides of the helmet brim and rotate the face shield over the SCBA face piece to protect the breathing apparatus from debris and water.
- Remove the gloves from the leg pockets and put them on. Ensure they cover the coverall wristlets.

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**Note.** Keep the SCBA breathing tubes outside the coverall and the flap of the helmet liner.

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## REMOVAL OF GEAR

3-79. To takeoff the gear, reverse the donning order. Remove the gloves, pull up the helmet face shield, loosen the helmet liner flap hook-and-loop-fastener, take the helmet off, and open the coverall collar closure. Pull the anti-flash hood down around your neck and take off the SCBA face piece. Take off the SCBA, pull off the anti-flash hood, step out of the boots, and remove the coveralls.

## STOWAGE

3-80. The firefighter ensemble should be stowed in the ensemble kit bag. The ensemble shall be preassembled and the bags located in, or near, Damage Control lockers so that they are easily accessible. Before stowing, ensure the ensemble is clean and dry. Stow the anti-flash hood over the face piece of the SCBA.

### WARNING

**DO NOT stow firefighter's protective clothing, SCBA, and SCBA cylinders inside the vessel's super structure or engine room.**

## HOSES

3-81. Fire hoses and nozzles will be of national hose (NH) thread specifications that shall be serviceable and connected to all fire stations. Fire hoses and nozzles will be maintained in accordance with this section. This section contains inspection and maintenance information about fire hose and fire hose nozzles used aboard Army watercraft.

## VISUAL INSPECTION

3-82. Visual inspections will be made on fire hoses, nozzles, and hose couplings. The following describes the inspection of each of these items.

## Fire Hose

3-83. Inspect each fire hose during weekly fire drills to determine that the hoses and nozzles are serviceable. Check to make sure that the fire hoses are free of debris. Inspect hose to ensure there is no evidence of mildew or rot, or damage by chemicals, burns, cuts, abrasions, and vermin. If the hose fails the visual inspection, it must be removed from service, destroyed, and replaced.

## Nozzles

3-84. All nozzles will be inspected at weekly fire drills and after each use. Inspection will include the following:

- Clear of obstructions in waterway.
- No damage to tip.
- Full operation of adjustments to appropriate spray patterns such as, flat spray, hollow cone, or full cone patterns.
- Proper operation of shutoff valve.
- No parts missing.

---

**Note.** If the nozzle fails the inspection for any reason, it must be removed from service and repaired or replaced. Nozzles attached to in-service fire hoses will be kept in the closed position. If during use there is an obstruction that cannot be removed by flushing the nozzle, disconnect the nozzle from the hose and remove the obstruction through the hose connection end. Attempting to force the obstruction out through the tip may damage the nozzle. Handle nozzles with care. Avoid dents or nicks in nozzle tips, as this may seriously affect the reach of the stream. Nozzle control valves will be opened and closed slowly to reduce pressure surges. This would eliminate unnecessary strain on the hose and couplings. After use, all nozzles will be flushed and inspected before being placed back in service.

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## Hose Couplings

3-85. Couplings will be kept in serviceable condition. After use, and during each pressure test of the hose, they will be visually inspected for the following:

- Damaged threads.
- Corrosion.
- Slippage on the hose.
- Out-of-round.
- Swivel (not rotating freely).
- Missing lugs.
- Other defects that impair operation.
- Gasket for presence, tight fit, and deterioration.

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**Note.** Couplings found defective will be removed from service and replaced. Do not drop couplings on steel deck or other hard surfaces. Doing this can cause damage to the threads. Do not allow vehicles to drive over couplings. Aluminum hose connections are not allowed. Per Title 46, CFR Volume 4, Part 95; “connections shall be brass, bronze, or other equivalent metal.”

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## HOSE AND COUPLING PRESSURE TEST PROCEDURE

3-86. Fire hose and couplings will be tested annually to the maximum pressure they may be subjected in service, but not less than 100 pounds per square inch (PSI). Pressure tests may be performed by vessel's crew. Any length of hose that fails the visual inspection or service test will be removed from service and destroyed.

3-87. The following pressure test procedure will be followed:

- Total length of test hose line will not exceed 300 feet. The hose line shall be straight without kinks or twists.

### **WARNING**

**Questionable hose or hoses that have been repaired or re-coupled will be tested one length at a time.**

- Connect the test hose line to a fire station valve. This valve must be manned during the test to prevent discharging a large volume of water in the event of a hose bursting during the test.
- Attach a nozzle to the far end of the hose line.
- With the fire station valve open and the end nozzle open, gradually increase the pressure to approximately 45 psi.
- Slowly close the end nozzle when the hose line is free of air and full of water.
- Close the fire station valve.
- Secure the hose line to avoid possible whipping or other uncontrolled reaction in the event of a hose burst.

### **WARNING**

**Clear all personnel from the area except those required to perform the remainder of the test procedure.**

- Check hose line for leakage at the couplings. Tightened couplings with a spanner wrench where necessary.
- Mark each hose at the back of each coupling with a felt tip marker to determine if the coupling moves on the hose during the test.
- Slowly increase the pressure to test pressure (not less than 100 psi) and hold for five minutes.
- Inspect for leaks, bubbles, and separation from ends while the hose line is at the test pressure.

### **WARNING**

**Personnel shall never stand in front of the free end of the hose, within 15 feet to the side of the hose, or straddle a hose during the pressure test.**

- If a section of the hose is leaking or bursts, terminate the test. Drain the hose line and remove and destroy the failed hose.
- After the five minute pressure test, shutdown the pump, open the end nozzle to relieve the pressure, and drain the hose line.
- Observe the marks placed on the hose at the back of the couplings. If the coupling has slipped or twisted, the hose has failed the test. Remove and destroy the failed hose.
- Enter the test results in the ship's log.
- All hoses shall be cleaned, drained, and dried before being placed in service or storage.

## **MARKING**

3-88. All fire hoses shall be marked with the vessel's name or number, test date, and test pressure.

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*Note.* Do not replace old fire hoses and nozzles unless they are damaged or are no longer serviceable

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## Chapter 4

# Damage Control Equipment

When an emergency occurs at sea, the crew must know how to save the vessel. Many times, it is not your own vessel you are saving, but another vessel in distress. The ability to put damage control knowledge to use without hesitation can mean the difference between life and death at sea.

## DAMAGE CONTROL OBJECTIVES

4-1. There are three basic objectives of shipboard damage control which can be defined as occurring before, during, or after the ship sustains damage. Briefly stated, these objectives are as follows:

- Take preliminary action before damage occurs. This includes maintenance of watertight and airtight integrity, preservation of reserve buoyancy and stability, removal of fire hazards, preventive maintenance and test of emergency and damage control fittings and equipment.
- After damage has occurred, the focus must change in order to minimize, contain and localize casualty damage by controlling flooding, dewatering, firefighting, and transport and care of injured crewmembers.
- Lastly, to accomplish repairs and recover from the casualty as soon as possible after sustaining damage. This is accomplished by segregating ruptured piping systems, reconfiguration, establishing casualty power, and regaining a safe margin of stability and buoyancy by re-enforcing shored and weakened structures and manning essential equipment, as well as posting the appropriate watches (shoring, re-flash,).

4-2. To repair battle damage, you must possess extensive knowledge of the available damage control equipment and materials. At the same time, you must be able to expeditiously analyze and determine the appropriate corrective actions needed. Should your vessel sustain a damaging hit, the damage must be investigated immediately. Precise reports from investigators that are forwarded in an expeditious manner are critical. These reports allow key damage control personnel to form a concise picture as to the extent of the damage. This process results in a determination of what actions are required to localize and overcome the casualty.

## DAMAGE CONTROL EQUIPMENT AND MATERIALS

4-3. The damage control equipment and materials required to make repairs to battle damage vary according to the nature of the damage. Since several types of damage can occur aboard ship, you must know how to use a wide variety of equipment and materials. The Allowance Equipage List has several repair locker inventory lists for various types of ships. A typical repair locker will usually contain some or most of the following equipment, depending upon the ship's allowance:

- |                                |                                     |
|--------------------------------|-------------------------------------|
| ● 18 breathing apparatus (BA.) | ● Fire-fighter's protective gloves. |
| ● Battle lanterns.             | ● Sealed-beam lights.               |
| ● Extension lights.            | ● Flashlights.                      |
| ● Sounding tapes.              | ● Rubber boots.                     |
| ● Helmet.                      | ● Rubber gloves.                    |
| ● Life jackets.                | ● Spare electrical cable.           |
| ● Hand tools.                  | ● Steel wedges.                     |
| ● Electrical tools.            | ● Hose and pipe flanges.            |
| ● Chain hoist.                 | ● Shoring kit and shoring batten.   |
| ● Screw and hydraulic jacks.   | ● Plugging kit.                     |

- Manila line.
- Forcible entry tools.
- X40J cable and jack boxes.
- Oxygen indicator.
- Combustible gas indicator (explosimeter).
- Four gas analyzers.
- Electrical kits.
- Portable Exothermic Cutting Unit (PECU).
- Supplied air respirator with self-contained breathing apparatus (SAR/SCBA).
- Decontamination equipment.
- Fire rakes and ladders.
- Pipe-patching kit (soft patches).
- Blower sleeves.
- Prefabricated patches (wood and steel).
- Sound-powered phones.
- Basket strainer.
- Submersible pump.
- Gas masks.
- CBR defense protective clothing.
- CBR defense detection equipment and markers.
- Nozzles and extra fire hose.
- In-line foam eductor.

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*Note, Vessels that have subgroups, some of this equipment is stowed in the unit lockers.*

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4-4. Additional damage control equipment is dispersed throughout the ship in designated areas. This equipment includes the following:

- Submersible pumps.
- Fire hose.
- Nozzles.
- Applicators.
- Aqueous film-forming foam (AFFF) cans.
- CO2 extinguishers.
- Dry-chemical extinguishers
- Portable gasoline-driven fire pumps (P 100 FIRE PUMP) and hoses.
- Eductors.
- Shoring kit.
- Shoring materials.
- Plate patches.
- Battle lanterns.
- Casualty power cables.
- Portable blowers.

## **RELIABILITY OF DAMAGE CONTROL EQUIPMENT**

4-5. The damage control organization cannot function without an adequate supply of damage control equipment. Frequent inspections are required according to PMCS guidelines. These inspections ensure that all damage control equipment tools, and materials on your ship's allowance list are actually on board. Compare the ship's allowance list with an accurate and up-to-date inventory list of onboard damage control equipment. Check to see that all damage control equipment is stowed or installed in its designated location and that it is readily accessible. Emergencies can be handled much more effectively if the equipment is available and if you do not have to waste time looking for it. The equipment assigned to each repair locker should be identified in such a way that each of the items can be returned to that repair locker after they have been used. A simple color code marking system can be used. All tools and equipment that belong to a certain repair locker should be marked with a striped band or a spot of identifying color of that repair locker.

4-6. Damage control equipment should NEVER be used for any purpose other than damage control. Damage control equipment is located throughout the ship, and some people are tempted to use it just because it is handy. This must NOT be allowed. All hands are responsible for damage control and must realize that their lives may literally depend upon the ready availability and condition of damage control equipment in an emergency.

## **DAMAGE CONTROL KITS**

4-7. At each repair locker a number of repair kits are made up and stowed in canvas bags. These kits are kept ready to be taken to the scene of damage. The kits should be constructed and packaged so they will fit through the smallest watertight scuttle on your ship. These kits are commonly called plugging kits, pipe-patching kits, and shoring kits.



4-8. All damage control kits and repair locker equipment must be inventoried according to PMCS requirements after each use. Each damage control kit should have a list of contents attached to the carrying strap. This list makes it relatively simple to inventory the contents of the kit. Any equipment or material found missing during the inventory should be replaced as soon as possible. Your ship's coordinated shipboard allowance list (COSAL) shows the amount of each item that is allowed for the ship. A stencil on the outside of the bag should identify each damage control kit.

4-9. Extra plugging and pipe-patching kits are made up for the engineering spaces. These extra kits are inventoried and maintained by the personnel assigned to the engineering spaces.

## **PLUGGING AND PATCHING MATERIALS**

4-10. A number of materials are available to plug and patch holes and to cover and secure patches. Plugging and patching materials include wooden plugs and wedges, wooden shoring, prefabricated wooden box patches in various sizes, rags, pillows, mattresses, blankets, kapok life jackets, metal plate, folding metal plate patches, flexible sheet metal patches, prefabricated steel box patches, bucket patches, and welded steel patches. Securing and gasket materials are also used for these purposes and some of the more commonly used materials are listed below.

### **Securing Materials**

4-11. Securing materials include assorted hook bolts, manila line, wire rope, chain, machine bolts, angle clips for welding, and shoring. Backup materials include mess tables, metal joiner doors, buckets, plywood or lumber, sheet metal, and metal plate.

### **Gasket Materials**

4-12. Gasket materials include sheet and strip rubber, leather, canvas, rags, and oakum.

## **HULL REPAIRS**

4-13. Hull repairs may be needed for any rupture, break, or hole in the ship's outer hull plating, particularly below the waterline which can allow seawater to enter the ship. If flooding continues uncontrolled, the ship will sink. When the underwater hull is pierced, there are only two possible courses of action. They are as follows:

- Plug the holes or openings.
- Establish and maintain flooding boundaries within the ship to prevent further progress of the flooding.
- Dewatering can be effective only after these measures have been taken.
- The most important thing to remember about flooding is that a ship can sink just as easily from a series of small and insignificant looking holes, as it can from one large and more dramatic looking hole. The natural tendency is to attack the obvious damage first and to overlook the smaller holes in the hull and in interior bulkheads. You may waste hours trying to patch large holes in already flooded compartments. Meanwhile, you disregard the smaller holes through which progressive flooding is taking place. In many cases, it would be better to concentrate on the smaller holes. As a rule, the really large holes in the underwater hull cannot be repaired until the ship is dry-docked.
- All holes in the hull, large or small, should be plugged completely as soon as possible. As an interim measure, all holes should be partially plugged if they cannot be completely plugged. Even a partial plug can substantially reduce danger of sinking by dramatically reducing the amount of water entering the ship.

- Holes in the hull that are at or just above the waterline should be given immediate attention. Holes in this location may not appear to be dangerous but they are. As the ship rolls or loses buoyancy, the holes become submerged and allow water to enter at a level that is dangerously high above the ship's center of gravity. These holes must be plugged at once. Give the holes at the waterline or on the low side priority (if the ship is listing), and then plug the higher holes.
- The same methods and materials used to repair holes above the waterline are also used, for the most part, in the repair of underwater holes. The repair of underwater holes tends to be more difficult. Therefore, any crew member who can repair underwater damage must certainly be able to repair similar damage above the waterline. For this reason, most of the discussion in this chapter will deal with the repair of underwater damage.

### **FACTORS AFFECTING UNDERWATER REPAIRS**

4-14. The primary factors that make it difficult to repair underwater holes are as follows:

- The pressure exerted by the water
- The relative inaccessibility of the damage

4-15. The difficulties caused by water pressure are often exaggerated. Actually, a hole 7 feet below the waterline is only subjected to a water pressure of about 3 pounds per square inch.

4-16. The formula provided below is used for computing the amount of water that could enter a ship through a hole in the hull. Figure 4-1 on page 4-5 shows the flooding effect of unplugged holes and of the same holes after inserting simple plugs. The volumes of flooding water are given in gallons per minute. The number of electric submersible pumps required to handle the flooding is also shown. It should be obvious that prompt plugging of holes is desirable. It can save the ship, it releases pumps for use elsewhere, and it saves wear and tear on the pumps that are in use.

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For computing the amount of water that could enter a ship through a hole in the hull at any one time, use the following formula.

$$Q = 0.6A \sqrt{2GH}$$

Where Q = Cubic feet of water per second.

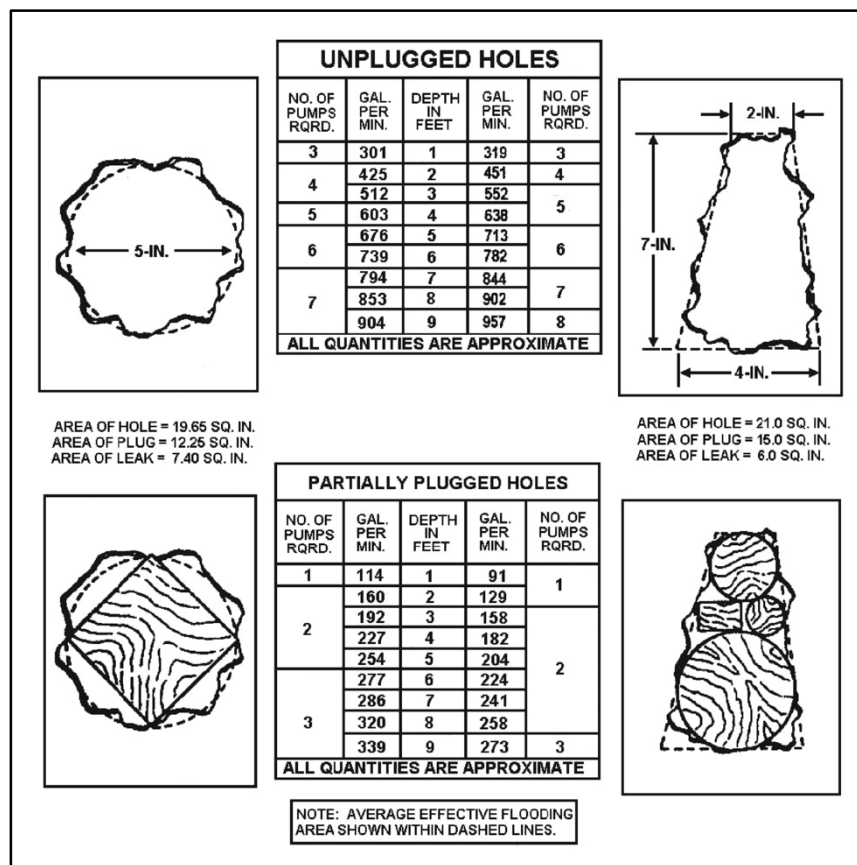
A = Area of the hole in square feet.

G = Gravitational constant of 32 feet per second squared (32FT/SEC<sup>2</sup>).

H = Height of water in feet (Depth of hole).

0.6 = Coefficient of discharge for sharp edged holes.

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**Figure 4-1. Flooding effect comparison; unplugged holes vs partially plugged holes**

**Note.** Average effective flooding areas shown within white lines. These figures show how important it is to put some kind of plug into any hole right away. All quantities are approximate.

**Note.** The pump capacities used are considerably under the rated capacity, usually 200 gallons per minute. However, if the pump strainers get clogged with debris, the actual capacities may be much less than the rated capacity.

## PLUGGING AND PATCHING HOLES

4-17. The procedures discussed here for plugging and patching holes are intended for emergency use. They are temporary repairs that can be done to keep the ship afloat while it is in action. In most cases, they do not call for elaborate tools or equipment. They involve principles that can be applied when using wooden plugs, prefabricated patches, or other readily available materials.

4-18. The two general methods of making temporary repairs to a hole in the hull are as follows:

- Put something in it
- Put something over it

4-19. In either case, the patches will reduce the area through which water can enter the ship or through which water can pass from one compartment to another.

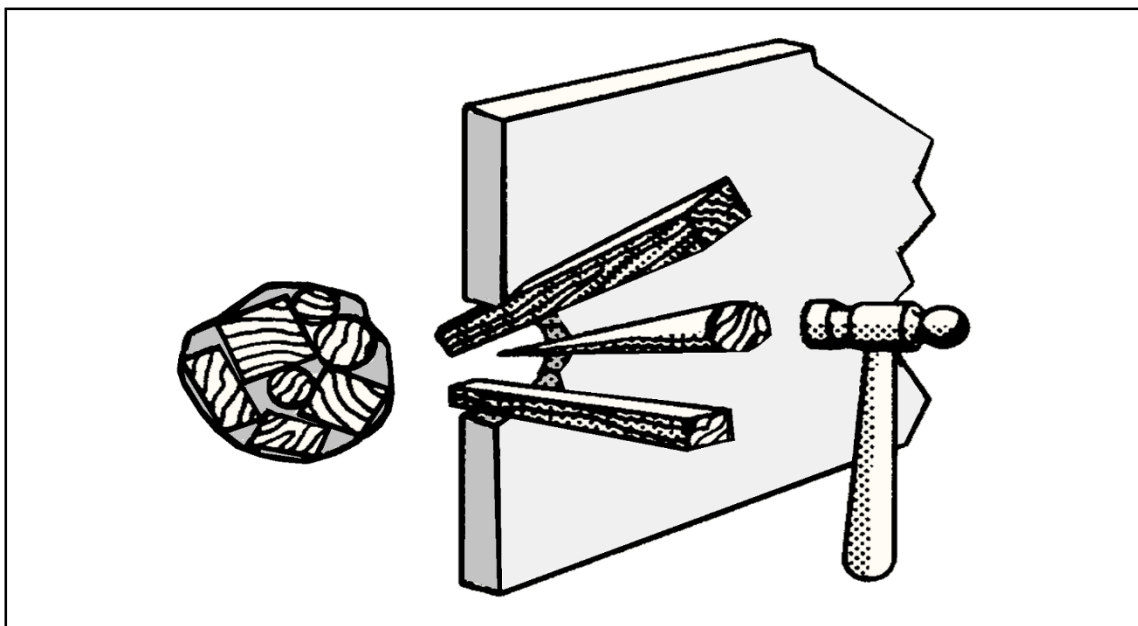
## Plugging

4-20. The simplest method of stopping up a fairly small hole is to insert some kind of plug. Plugs made of softwood, such as yellow pine or fir, are quite effective for plugging holes up to about 3 inches by 3 inches in size. Sometimes you may use these plugs to plug larger holes as well.

4-21. The items in a plugging kit are as follows:

- A canvas bag with a carrying strap approximately 30 inches deep and 12 inches in diameter
- Softwood plugs; a minimum of 10 plugs in various sizes from 1 inch to 10 inches in diameter
- Five pounds of oakum or rags
- One hatchet
- One cold chisel
- One metal caulking iron
- Wedges made of softwood; a minimum of eight wedges, 2 inches by 4 inches and 12 inches long
- One maul or sledge
- One hammer; a minimum 2 pounds in weight
- One crosscut handsaw for cutting wood

4-22. The plugs and wedges may be used individually if they fit the hole. Often however, it is best to use a combination of conical, square-ended, and wedge-shaped plugs to make a better fit in the hole. One such combination of plugs is shown in figure 4-2.



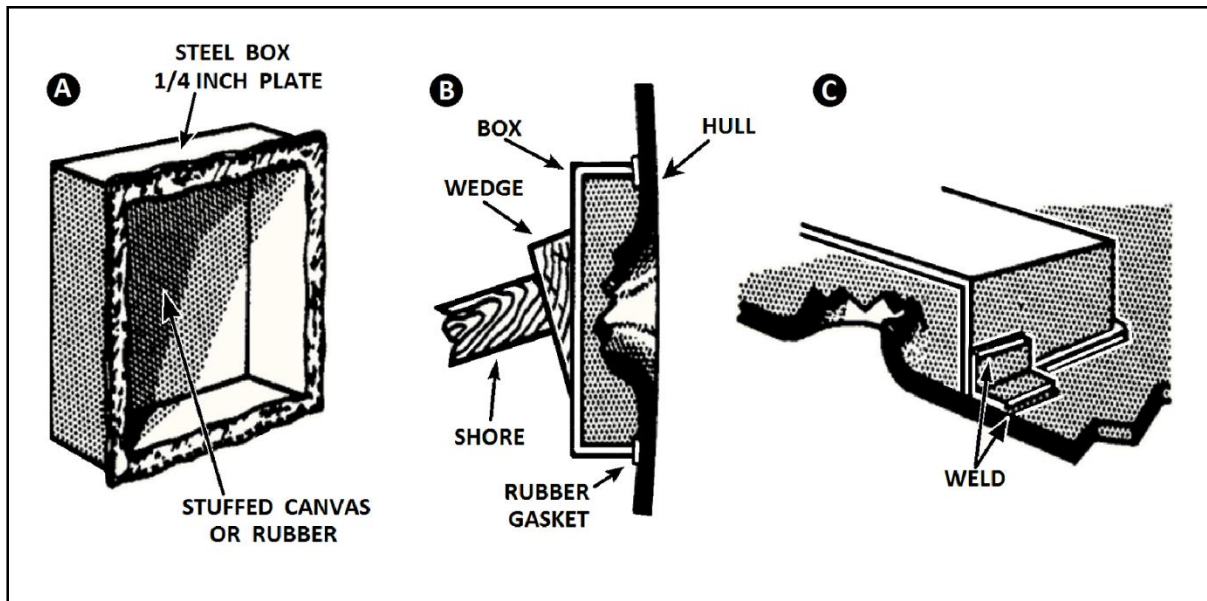
**Figure 4-2. Combination of plugs used to plug a hole**

4-23. It is best to wrap each plug with lightweight cloth before inserting it. The cloth tends to keep the plugs in place and fills in some of the gaps between the plugs. In most cases, plugs will not make a watertight fit. However, you can substantially reduce the rate of leakage by using the plugs and then caulking the remaining leaks with rags, oakum, and smaller wedges. Square-ended plugs tend to hold better than conical plugs in holes located in plating that is one-fourth of an inch or less in thickness.

4-24. Most wooden plugs are inserted from the inside of the ship. When plugging a hole in this manner, you must contend with the metal edges that are protruding inward. You normally will not have this problem when plugging a hole from the outside of the ship. However, plugs on the outside of the ship cannot be tended easily nor will they hold very well over an extended period of time. If it is necessary to insert the plugs from the outside of the hull, fit the inboard ends of the plugs with screw eyes. A line running from each screw eye and secured to a solid structural member inside the ship will help to keep the plug in place.

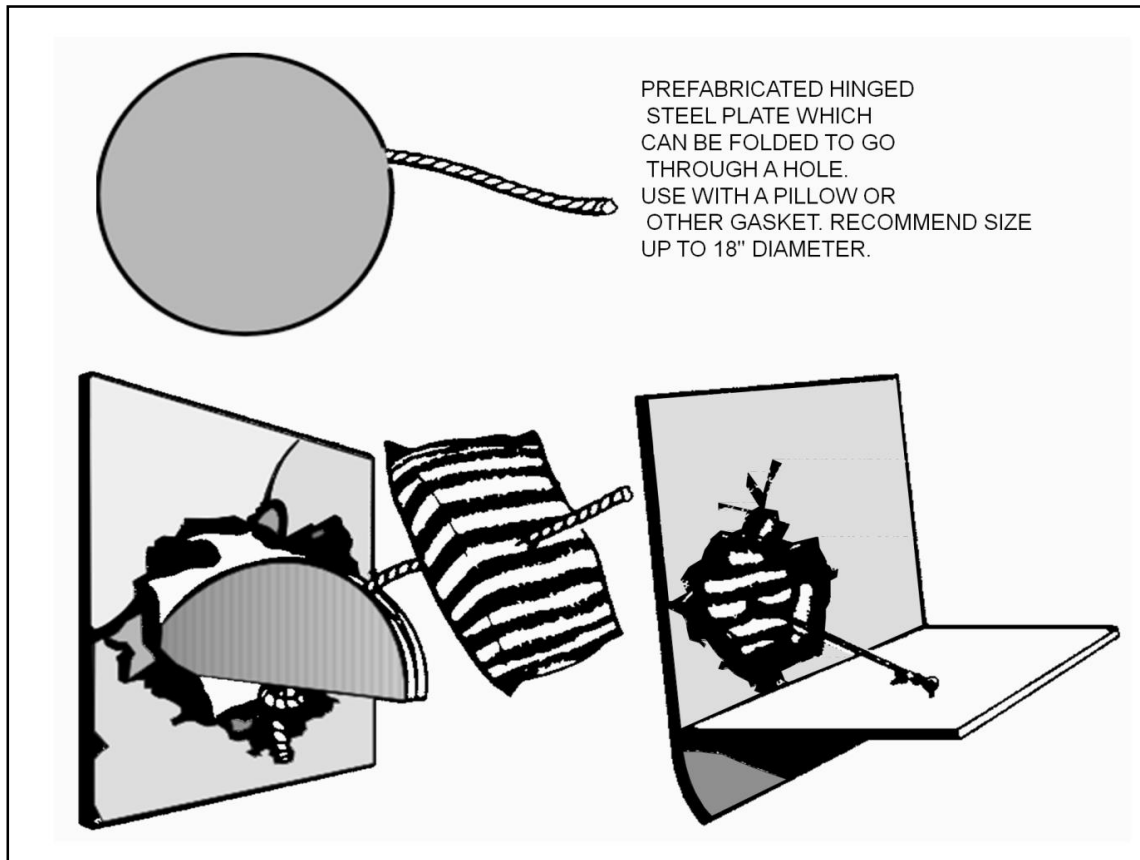
## Patching

4-25. Box patches are effective for use over holes that have jagged edges projecting inboard. View A of figure 4-3 shows a typical metal box patch; view B shows a metal box patch held in place by shoring; and view C shows a metal box patch welded in place over a hole that has jagged edges.



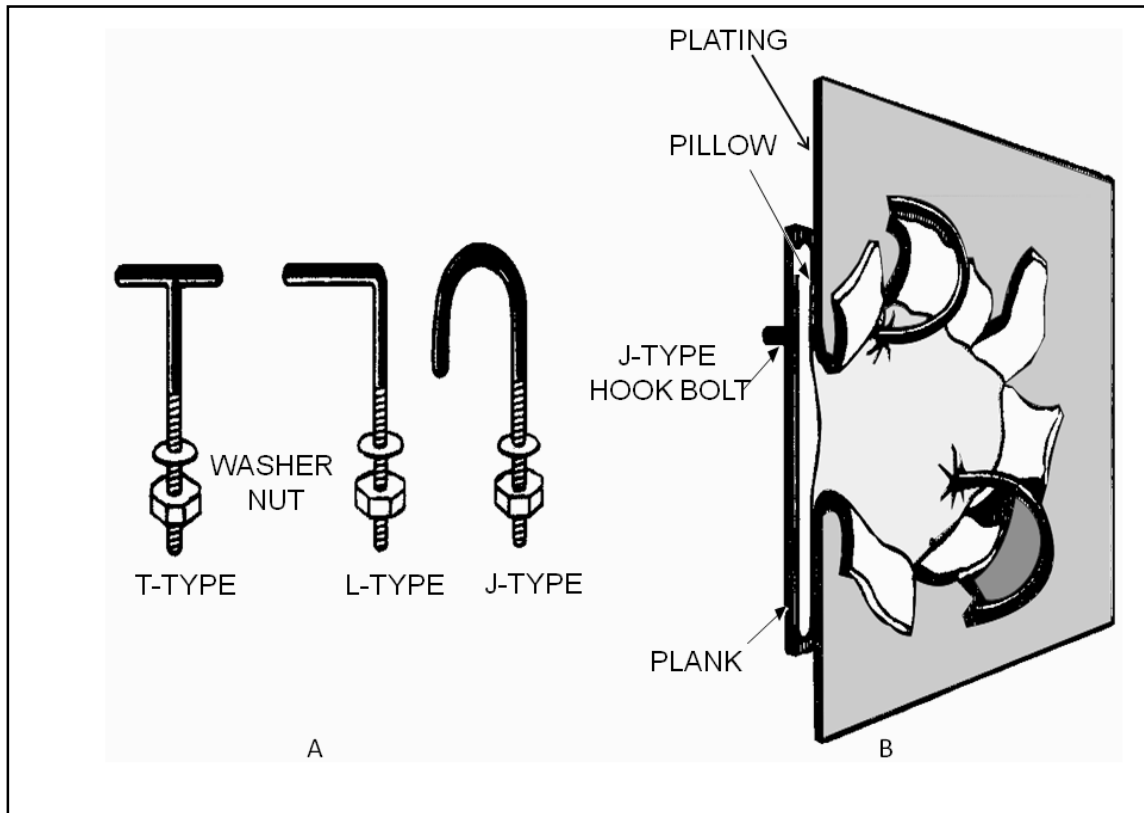
**Figure 4-3. Application of a box patch**

4-26. A hinged patch is designed for use over relatively small holes. This patch has no vertical support to hold it in place. Figure 4-4 on page 4-8 shows a hinged plate patch before, during, and after installation.



**Figure 4-4. Application of a hinged plate patch**

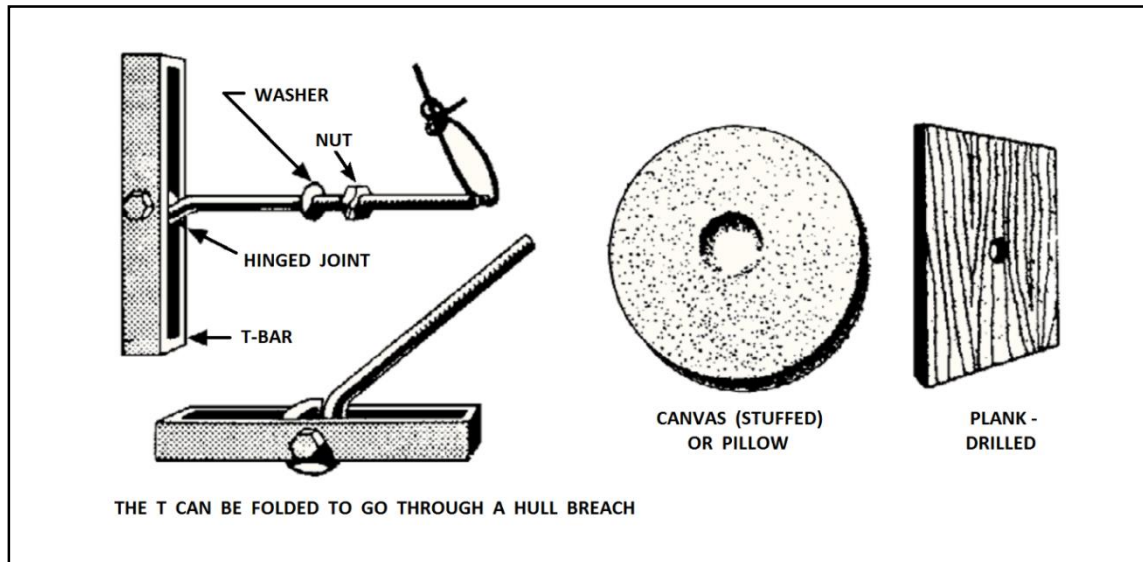
4-27. A hook bolt is a long bolt that is usually fabricated from round steel stock. Hook bolts come in a variety of diameters and shapes. The head is shaped so that the bolt can be hooked to the plating through which the head has been inserted. Figure 4-5 on page 4-9 shows T-shaped, L-shaped, and J-shaped hook bolts and how the hook bolts are used to apply a patch. The long shanks are threaded and are provided with nuts and washers. Wood (or sometimes steel) strongbacks are used with hook bolts.



**Figure 4-5. A. Types of hook bolts, B. Use of hook bolts in applying a patch**

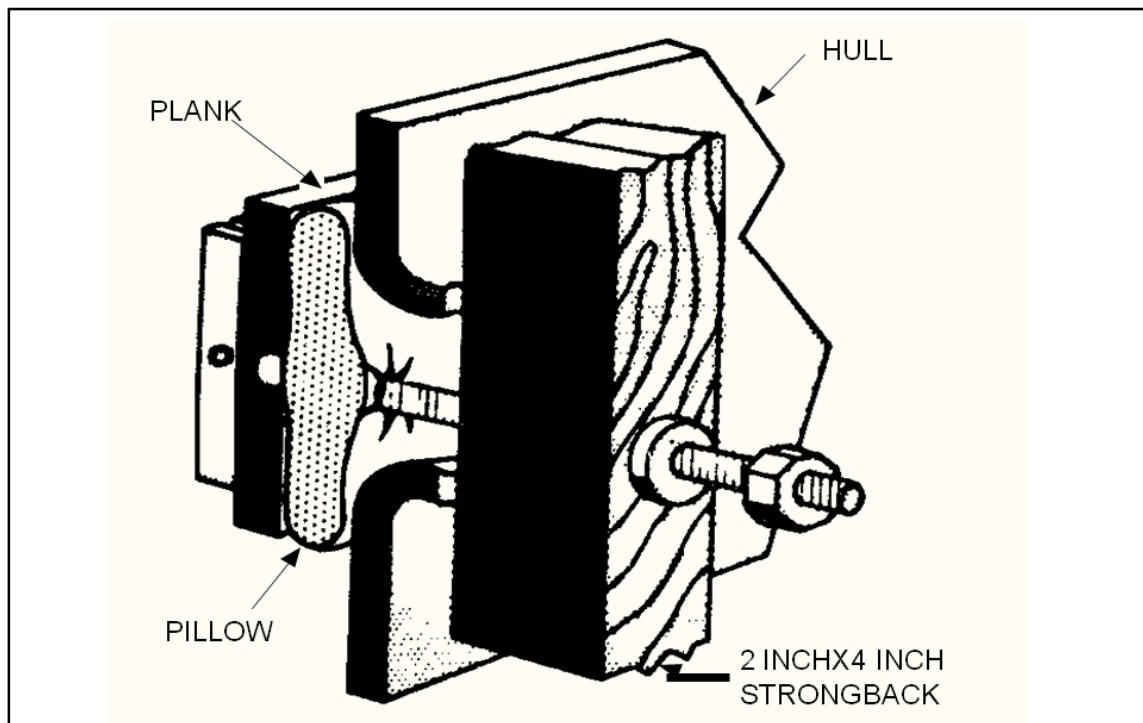
4-28. To use a hook bolt, insert the head end of the bolt through the hole in the hull. Rotate or adjust the bolt until it cannot be pulled back through the hole. Slide a pad or gasket that is backed by a plank or strongback over the bolt. Secure the patch by tightening the nut. Generally, these bolts are used in pairs. Hook bolts can be used with a variety of patches and in various combinations.

4-29. The folding T-shaped hook bolt has a hinge where the shank joins the crosspiece. This bolt can be folded and inserted through a small hole. When the bolt is pulled back, the crosspiece catches on the hull plating. By using this bolt, a crewmember standing inside the ship can put a patch on either the inside or the outside of the ship. By using a retaining line on the bolt, a strongback and a pillow can be threaded over the line and the entire patch folded and placed through the hole. When the line is hauled in, the patch fits against the ship. The patch can be re-adjusted to give a tighter fit. It is also possible to push the pillow and plate over the shank inside the ship to make an inside patch. Nuts and washers are provided to hold and tighten a patch; often large wing nuts are used. Figure 4-6 on page 4-10 shows one way in which a folding T-shaped hook bolt can be used to secure a patch.



**Figure 4-6. Materials used in assembling a folding T patch**

4-30. Ordinary feather pillows have a tendency to ball up when they are wet and do not provide a uniform surface when used to patch holes. For this reason some ships may fabricate pillows made of canvas and oakum. Figure 4-7 is an example of one method of installing a folding T patch.



**Figure 4-7. One method of installing a folding T patch**

4-31. It may become necessary to improvise patches by using whatever material is readily available. This calls for skill and a certain amount of ingenuity. Hinged or folding prefabricated patches are usually the easiest to use and in most cases, are the most effective. However, if these are not available, it will be necessary to improvise patches



## SHORING

4-32. Shoring is often used aboard ship to support ruptured decks, to strengthen weakened bulkheads and decks, to build up temporary decks and bulkheads against the sea, to support hatches and doors, and to provide support for equipment that has broken loose.

4-33. Knowing when to shore is a problem that cannot be solved by the application of any one set of rules. Sometimes the need for shoring is obvious. Examples are loose machinery or damaged hatches. However, dangerously weakened supports under guns or machinery may not be so readily noticed. Although shoring is sometimes done when it is not really necessary, the best general rule is this: "If in doubt, shore it."

## SHORING MATERIALS

4-34. The basic materials required for shoring are as follows: shores, wedges, plugs, sholes, and strongbacks.

- A shore is a portable beam.
- A wedge is a block, triangular on the sides and rectangular on the butt end.
- A plug is conical in shape and is made of soft wood.
- A shole is a flat block that may be placed under the end of a shore to distribute pressure.
- A strongback is a bar or beam of wood or metal that is used to distribute pressure or to serve as an anchor for a patch. The strongback is often shorter than a shore.

4-35. Many other items are used in connection with shoring. They include wooden battens, claw hammers, mauls and sledges, handsaws, mattresses, pillows, axes, hatchets, wood clamps, chain falls, electric welding machines, oxyacetylene cutting outfits, cold chisels, wood chisels, nails, wooden plugs, packing sheets, turnbuckles, screw jacks, hydraulic jacks, bolts, nuts, and washers. The vessel's BII lists the quantity of such gear that each ship should carry on board

### Shores

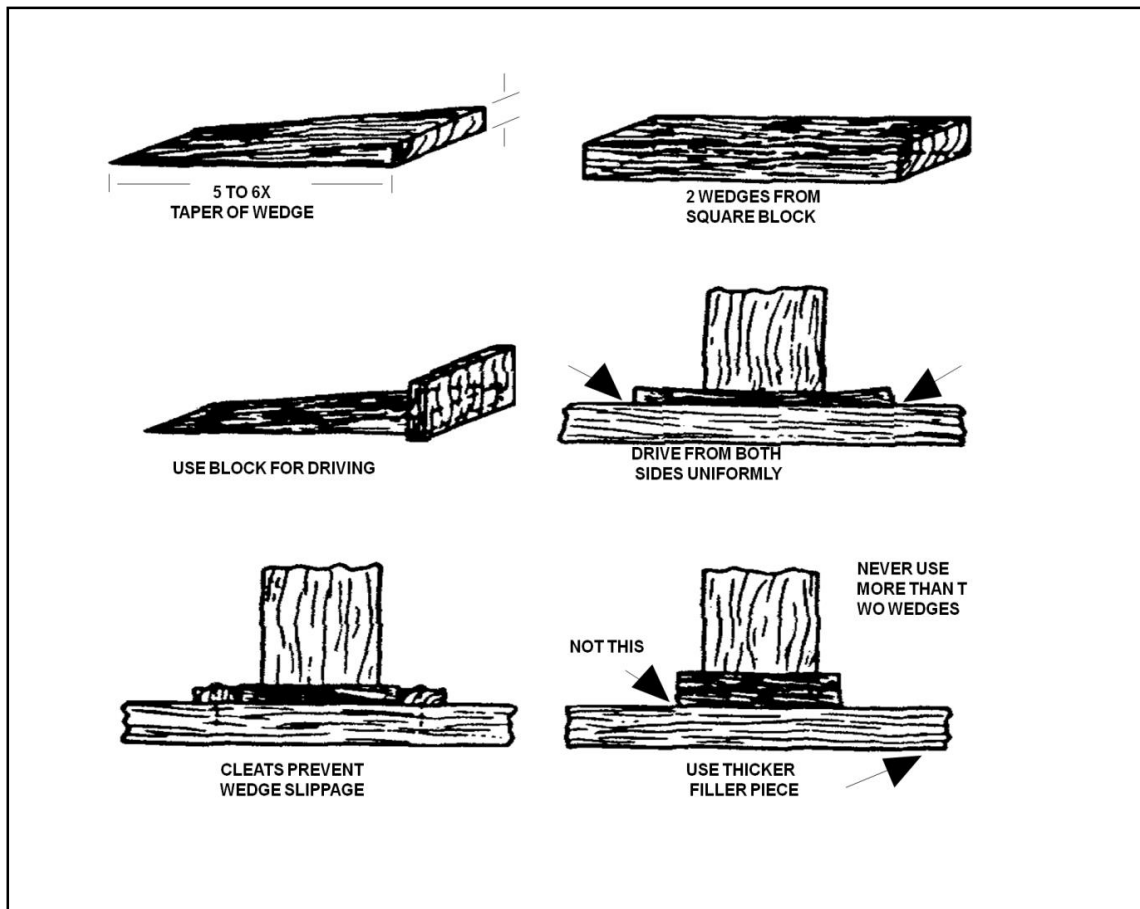
4-36. The best woods available for shores are Douglas fir and yellow pine. Hemlock and spruce may also be used. However, they are not as good because they are not as strong. Any wood used for shores should be straight grained and relatively free of knots and cracks. Green timbers are not as strong as cured timbers. If it is necessary to use a poor quality wood, use more shores than would be required for shores of a better quality wood. Shores authorized for shipboard use are treated with a fire-resisting chemical. They should NEVER be painted with an ordinary paint.

4-37. The length of a shore should never be more than 30 times its minimum thickness. Thus shores that have dimensions of 4 inches by 4 inches or 4 inches by 6 inches should not be any longer than 10 feet. A shore that is 6 inches by 6 inches should not be any longer than 15 feet. The shorter the shore is in relation to its thickness, the greater the weight it will support. Shores should normally be carried aboard ship in 16-foot and 18-foot lengths that can be cut to the required lengths, when needed

### Wedges

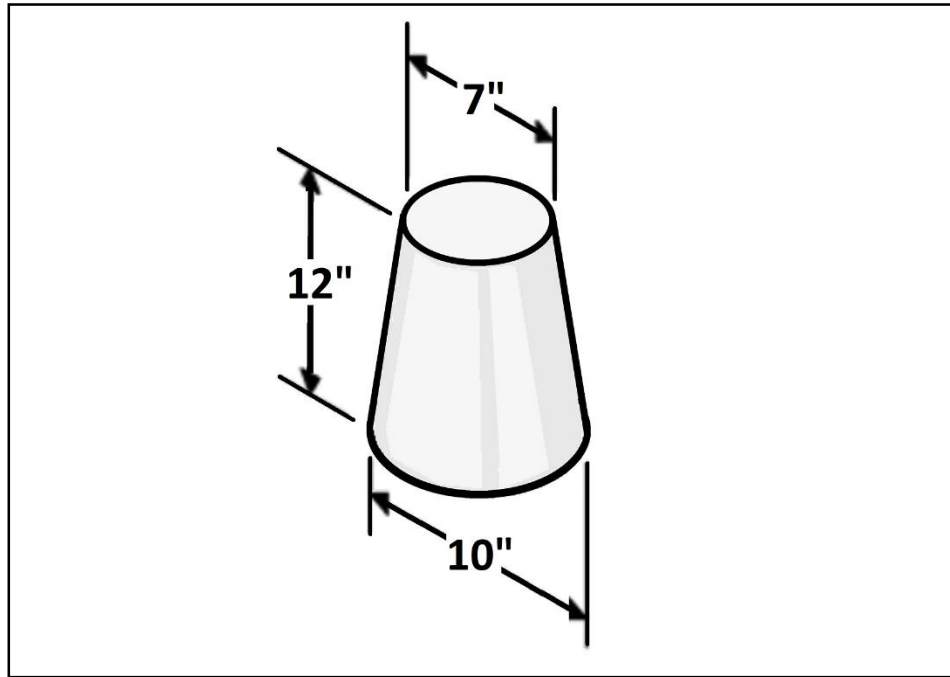
4-38. Wedges should be of softwood, preferably fir or yellow pine. They should be cut with a coarse saw and left rough and unpainted. This allows the wedges to absorb water and hold better than if they are smoothed or painted. A few hardwood wedges should be kept on hand for special uses, since they resist crushing better. However, hardwood wedges cannot be used for all shoring because they have a tendency to work loose. When hardwood wedges are used, they must be checked frequently.

4-39. Wedges should be approximately the same width as the shores with which they are used. They may be made with various angles at the leading edge, but a blunt wedge will not hold as well as a sharp one. A wedge should be about six times as long as it is thick. Thus a wedge to be used with a shore that is 4 by 4 inches should be about 4 inches wide, 2 inches thick, and 12 inches long. Figure 4-8 on page 4-12 shows some wedges and how they are used.



**Figure 4-8. Wedges**

4-40. Conical tapered plugs are made of soft wood and are used in patching and plugging operations for pipe and hull repairs. They are available in four sizes; 1 x 0 x 3 inches, 2 x 0 x 4 inches, 3 x 0 x 8 inches, and 5 x 1 x 10 inches. See figure 4-9 on page 4-13 for an example of how to measure a plug for identification. Plugs are authorized by the vessel's BII and will be maintained in a dry location as specified by the vessel's damage control plan.



**Figure 4-9. Example of how to measure a plug for identification, end width (10") x point width (7") x length (12")**

## **SHOLES**

4-41. Sholes should be made of Douglas fir or yellow pine planks that are at least 1 inch thick and 8 inches to 12 inches wide. Nailing cleats across two or more widths of planking can make wider sholes. A single plank may have to be cleated at the ends to keep it from splitting. Do not fabricate sholes in advance of the actual need for them; prefabricated sholes would probably not fit where they are needed. The use of a shole is shown in figure 4-10 on page 4-14.

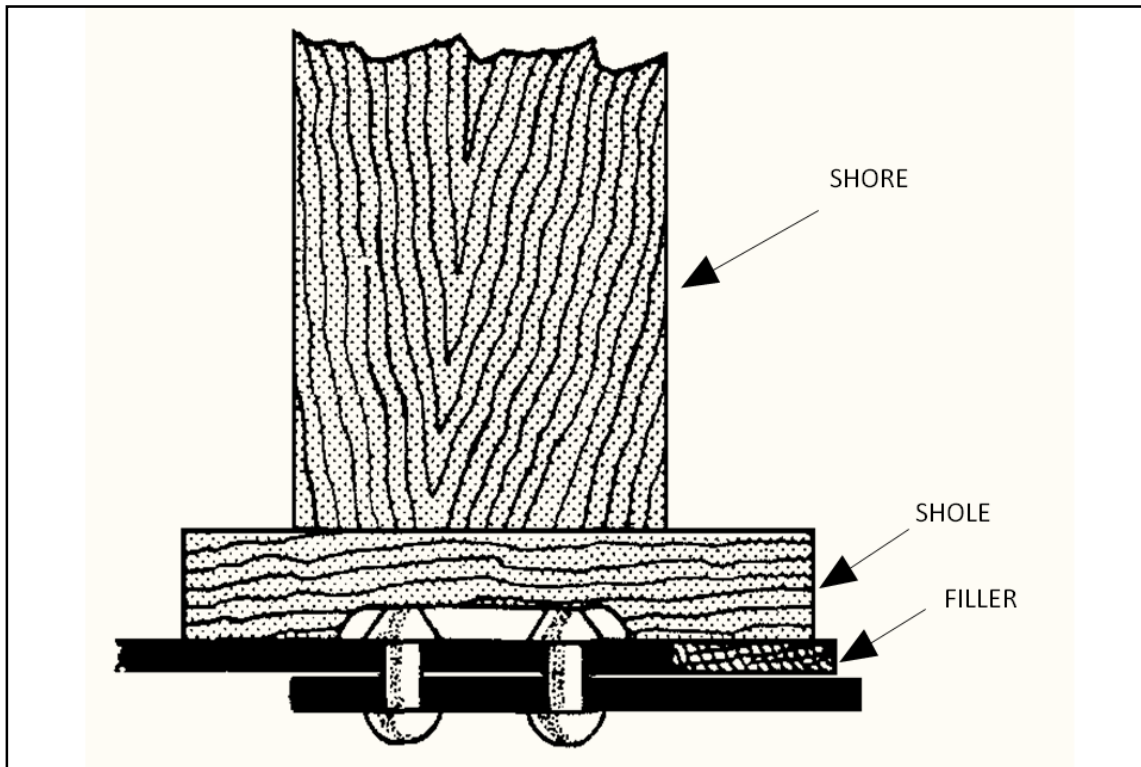
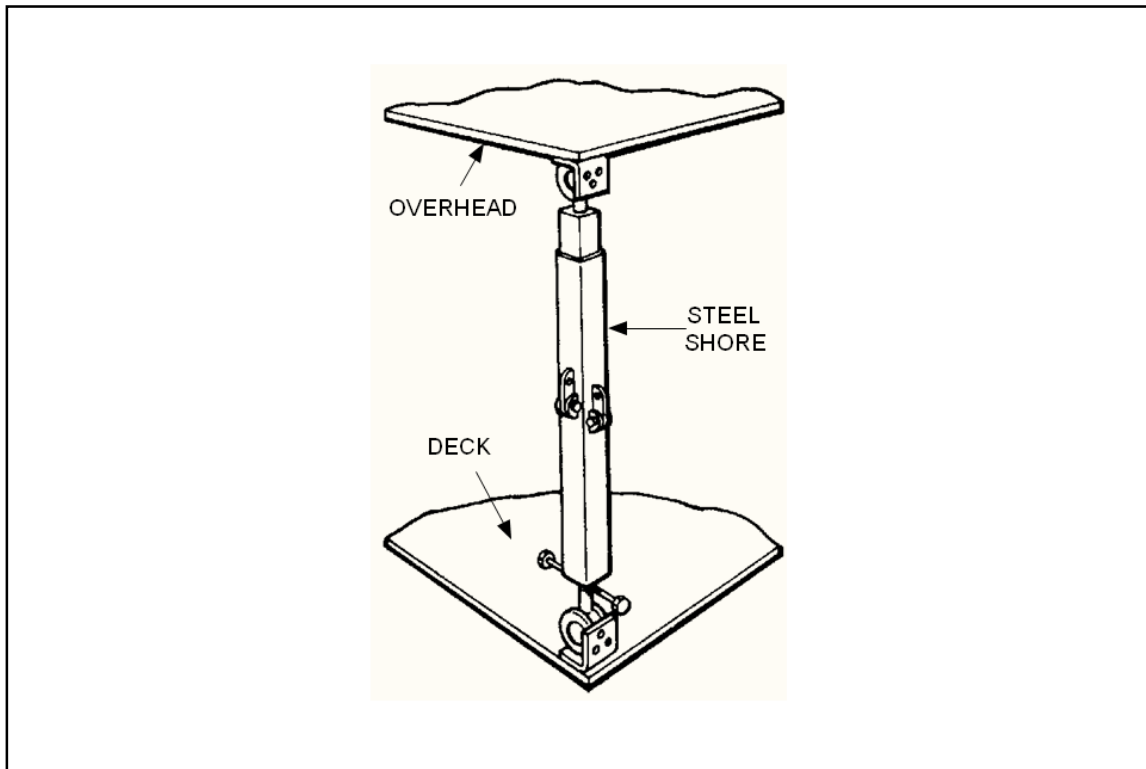


Figure 4-10. Use of a shore

## METAL SHORES

4-42. Several types of telescopic steel shores are used to make temporary repairs and some may be used for immediate repairs. The metal shores normally will have pins or locking devices and are fitted with a hinged shoe at each end. The pins or locking devices are used to adjust the length of the shore. The hinged shoe may be easily adjusted to any angle and then welded in place. The newer types of metal shores are shown in figure 4-11 on page 4-15 and are also fitted with screw jacks or swivel (ball-and-socket) bases.



**Figure 4-11. Steel shore supporting overhead deck or load**

4-43. The steel shores are available in two models:

- Model 3-5 is adjustable from a minimum of 3 feet plus or minus 3 inches, to a maximum of 5 feet plus or minus 3 inches. It will support a maximum vertical load of 20,000 pounds when closed to within 1 inch of the screw jack. It will support a maximum vertical load of 12,000 pounds when fully extended.
- Model 6-11 is adjustable from a minimum of 6 feet plus or minus 3 inches, to a maximum of 11 feet plus or minus 3 inches. It will also support a maximum vertical load of 20,000 pounds when closed to within 1 inch of the screw jack. It will support a maximum vertical load of 6,000 pounds when fully extended.

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**Note.** The newer models of the steel shores come in two sizes; 4 feet 6 inches to 7 feet and 7 feet to 12 feet.

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4-44. These shores consist of two telescoping, square, steel tubes. Four spring-loaded locking devices, a swivel baseplate, and a screw jack are on the outer tube. A swivel baseplate is on one end of the inner tube. Each side of the shore has a spring-loaded locking device. Each locking device is on the same plane as the locking device on the opposite of it. However, there is a 2 1/4-inch offset of the adjacent locking devices.

4-45. The steel shores must be maintained in good operational condition. The tubes must slide easily, and the swivel joints must move freely. The threads of the screw jack must not have any paint on them. Both the swivel joints and the screw jack threads are to be clean and greased. All of the holes and slots are to be open and free of excess paint.

4-46. Steel wedges are more valuable for prying things apart than for actual shoring. Steel wedges may be used in conjunction with wooden wedges to take some of the wear and pressure off of the wooden wedges. Steel wedges can also be welded into place when making semipermanent repairs.

4-47. Steel shores are better than wooden shores for use under the ends of iron or metal pipe being used as a temporary stanchion because metal pipe can easily cut through wooden shores.

4-48. Although steel bars, angle irons, and pipe can be used for strongbacks, their tendency to spring back and forth under variable loads must be considered. These materials can also be used for making semipermanent repairs when time is available.

### **SHORING KIT**

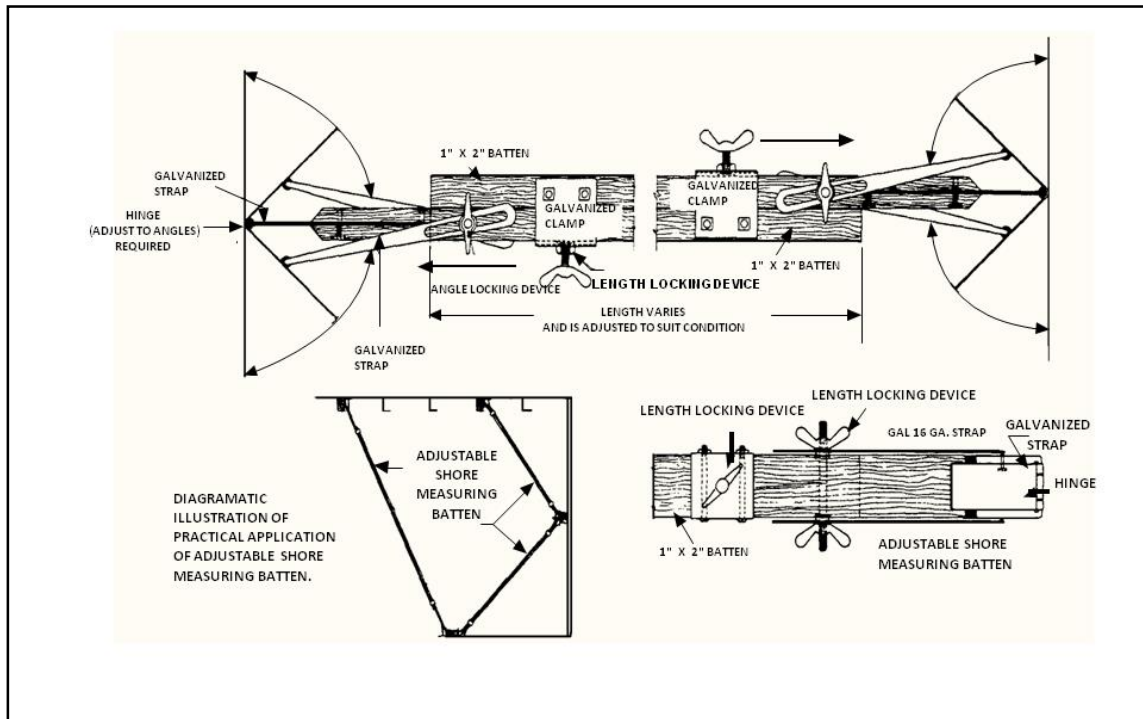
4-49. Shoring kits are small enough to go through scuttles and other small openings. The items normally contained in a shoring kit are:

- A canvas carrying bag that is approximately.
- 30 inches deep and 12 inches in diameter.
- One 10-pound sledge.
- One 8-point crosscut handsaw.
- One 10-foot metal tape rule.
- One 50-foot metal tape rule.
- One claw hammer.
- One hatchet.
- One 3/4-inch cold chisel.
- One 1-inch wood chisel.
- Eight adjustable clamps; four 6 inches and four 8 inches in nominal size.
- One caulking hand tool.
- One 24-inch carpenter's square.
- One electric hand lantern.
- Eight 2- by 4-inch softwood wedges.
- One bag of nails; two pounds each of 20d and 30d common nails.
- Five pounds of oakum or rags.
- Five pounds of sand.
- Several sections of shoring; 4 inches by 4 inches by 10 feet.

### **MEASURING AND CUTTING SHORES**

4-50. The most rapid and accurate way to measure a shore for cutting is to use an adjustable shoring batten similar to the one shown in figure 4-12 on page 4-17. These battens can be made up from items carried aboard ship. Each repair party locker is required to have a shoring batten.

4-51. To use the shoring batten, extend it to the required length and lock it with the thumbscrews on the length locking device. Then measure the angles of cut by adjusting the hinged metal pieces at the ends of the batten. Lock the angle locking devices in place. Lay the batten along the shore. Mark and cut the timber to the proper length and angle. Shores should be cut one-half of an inch shorter than the measured length to allow space to install wedges.



**Figure 4-12. Shoring batten**

4-52. If a shoring batten is not available, measure the shores for length by using a folding rule or a steel tape and a carpenter's square. The step-by-step procedure for measuring shores in this way are listed below. Figure 4-13 on page 4-18 provides a graphic depiction of these steps:

4-53. Step 1. Measure distance A from the center of the strongback to the deck. This distance is known as the "rise." Then measure distance B from the edge of the anchorage to the bulkhead. This distance is known as the "uncorrected run." Subtract the thickness of the strongback from measurement B. This distance is now known as the "corrected run."

4-54. Step 2. Lay off the measurements A and B on a carpenter's square, using the ratio of 1 inch to 1 foot. Rule measurement is taken to the nearest one-sixteenth of an inch. To maintain the 1-inch to 1-foot ratio, use the measurements listed in table 4-1 on page 4-18 as a guide.

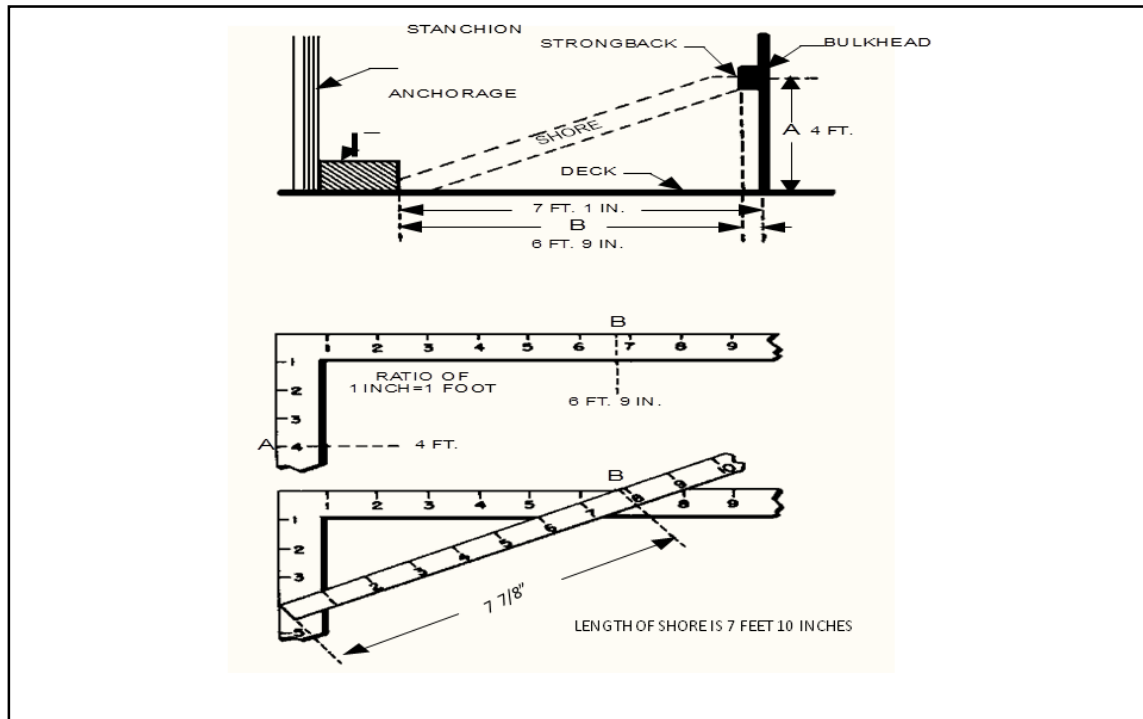


Figure 4-13. Measuring length of shore

Table 4-1. Actual rule measurement and measurement on a Carpenter's square

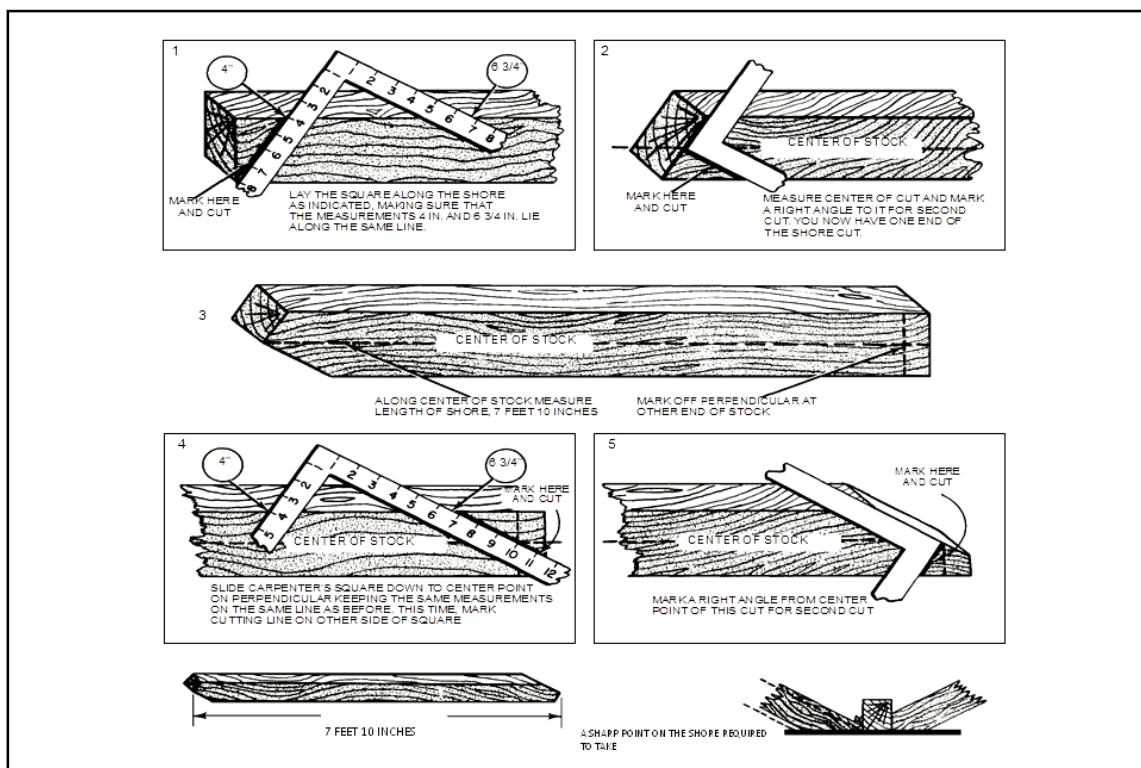
<i>Actual rule measurement</i>	<i>Measurement on carpenter's square</i>
$\frac{3}{4}$ inch	$\frac{1}{16}$ inch
$1 \frac{1}{2}$ inches	$\frac{1}{8}$ inch
$2 \frac{1}{4}$ inches	$\frac{3}{16}$ inch
3 inches	$\frac{1}{4}$ inch
$3 \frac{3}{4}$ inches	$\frac{5}{16}$ inch
$4 \frac{1}{2}$ inches	$\frac{3}{8}$ inch
$5 \frac{1}{4}$ inches	$\frac{7}{16}$ inch
6 inches	$\frac{1}{2}$ inch
$6 \frac{3}{4}$ inches	$\frac{9}{16}$ inch
$7 \frac{1}{2}$ inches	$\frac{5}{8}$ inch
$8 \frac{1}{4}$ inches	$\frac{9}{16}$ inch
9 inches	$\frac{3}{4}$ inch
$9 \frac{3}{4}$ inches	$\frac{13}{16}$ inch
$10 \frac{1}{2}$ inches	$\frac{7}{8}$ inch
$11 \frac{1}{4}$ inches	$\frac{15}{16}$ inch
12 inches	1 inch

4-55. Step 3. Measure the diagonal distance between A and B. In the example given in figure 4-13, this distance is  $7 \frac{7}{8}$  inches. Because of the 1-inch to 1-foot ratio, the distance in feet would be  $7 \frac{7}{8}$  feet or 7 feet 10  $\frac{1}{2}$  inches.



4-56. Step 4. Subtract one-half because shores should be cut one-half of an inch shorter than the measured distance to allow for the required wedges. Thus the final length of the shore should be 7 feet 10 inches.

4-57. The carpenter's square may also be used to measure the angles of cut and to mark the shore for cutting (as depicted in figure 4-14). Using the same measurements as in the previous example, follow the steps below.



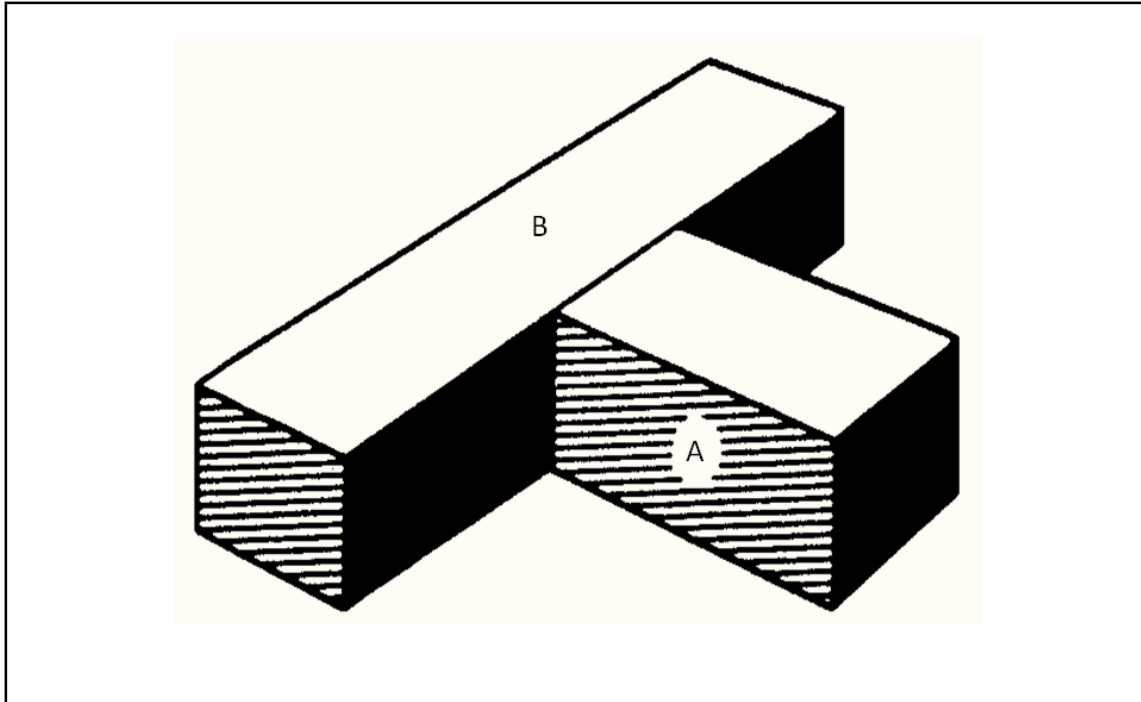
**Figure 4-14. Cutting the angles of a shore**

- Step 1. Lay the square along the shore, as shown in part 1 of figure 4-14, making sure that the measurements 4 inches and 6 3/4 inches lie along the same line. Cut the shore to this line.
- Step 2. Measure the center of the cut and mark a right angle to it for the second cut. Saw to the line. You have now completed cutting one end of the shore.
- Step 3. Along the center of the timber, measure the length of the shore (7 feet 10 inches) and mark off a perpendicular line at the other end of the shore.
- Step 4. Slide the carpenter's square down to the center point on the perpendicular. Keep the same measurements on the same line as before in step 1. This time, mark the cutting line on the other side of the square.
- Step 5. Mark a right angle from the center point of this cut for the second cut. Make your cuts. You now have a shore that is 7 feet 10 inches long with the ends properly cut to fit the measurements.

4-58. The proper cutting of shores is an important part of any shoring operation. Shores are usually cut with a hand-held circular saw. However, you may use an ordinary carpenter's handsaw. All repair party personnel should be instructed in the correct use of these tools. Shores that are poorly cut may cause a delay in completing the shoring job and may cause failure of the shoring structure. You will find that the wedges and shores will not fit properly if the shores are not cut correctly. Wet timbers are particularly hard to cut unless the proper methods of sawing are used. In cutting heavy shores, a lumberjack crosscut saw will save a good deal of time. Chisels, axes, and hatchets are also used to cut shores.

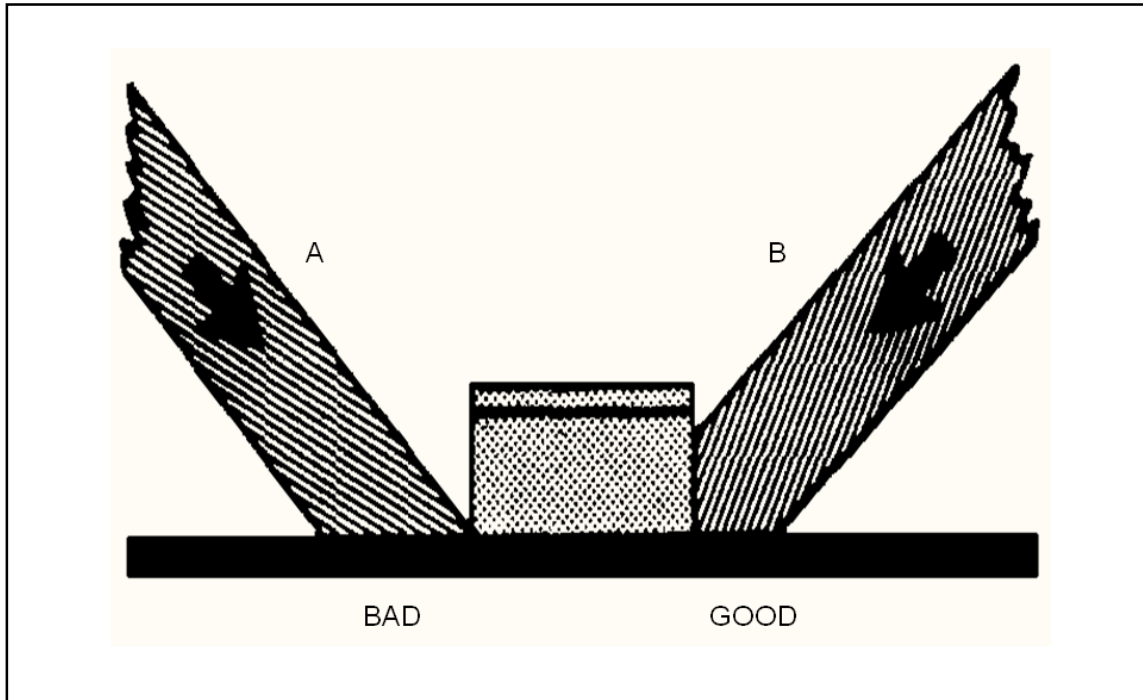
## TRIMMING SHORES

4-59. Shores must be trimmed to fit the shoring structure. The trimming must be done in such a way as to prevent splitting or chipping of the shores. If shore A in figure 4-15 is to fit against a plane surface of shore B and if it must take a load in compression, the end of shore A must be cut square and perpendicular to its long axis.



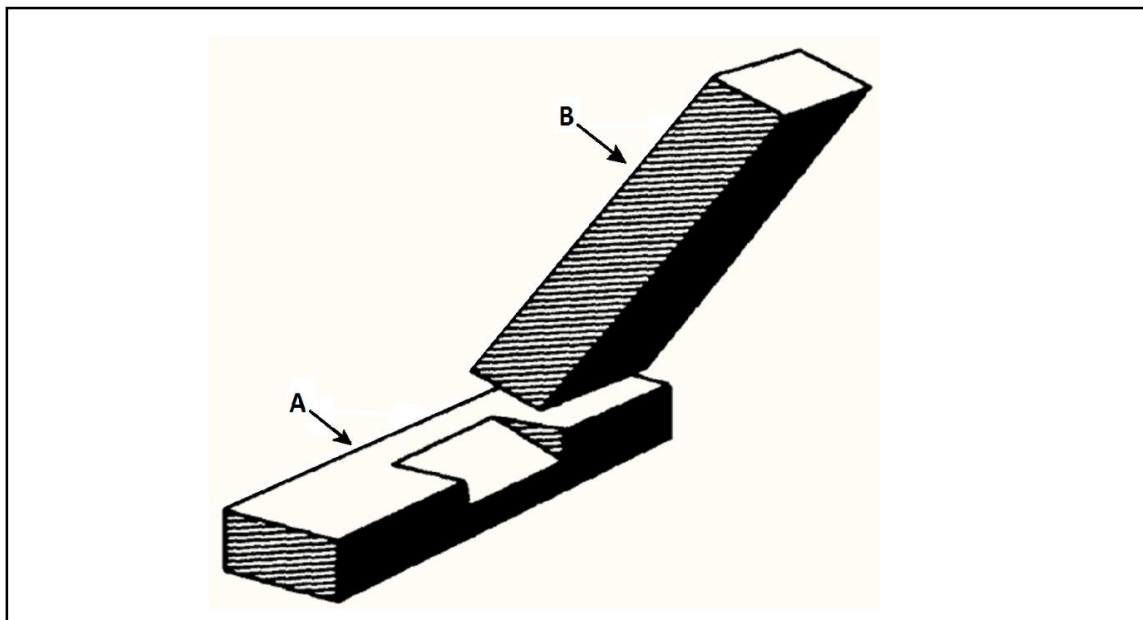
**Figure 4-15. Trimming shore to shore**

4-60. A sharp point must never be used when a shore will be required to withstand pressure. A pointed end will slip and curl and allow the shore to work loose and move. Figure 4-16 on page 4-21 shows the correct and incorrect ways to trim shores to present a flat surface at each pressure area.



**Figure 4-16. Trimming shore to deck**

4-61. Shores are sometimes notched at the end to fit against other shores. However, this method should not be used if you expect any great pressure. A safer method is to cut a socket in the side of one shore and fit the butt of the other shore into the socket. This method is shown in figure 4-17.



**Figure 4-17. Socket cut in shore**

### **GENERAL SHORING RULES**

4-62. Most shoring is done to support bulkheads that are endangered by structural damage or weakness caused by a hit or by the pressure of flooding water. The pressure on the bulkhead of a flooded compartment

is tremendous. Expert shoring is required to hold such bulkheads in place. Some of the general rules to remember in connection with shoring bulkheads are as follows:

- Always allow a large margin of safety. Use MORE shores than you think you need, rather than fewer.
- Spread the pressure. Make full use of strength members by anchoring shores against beams, stringers, frames, stiffeners, stanchions, barbettes, and so forth. Place the legs of the shoring against the strongback at an angle of  $45^\circ$  or  $90^\circ$  if at all possible. Figure 4-18 shows the simplest and strongest shoring structure; figure 4-19 on page 4-23 shows shoring angles.

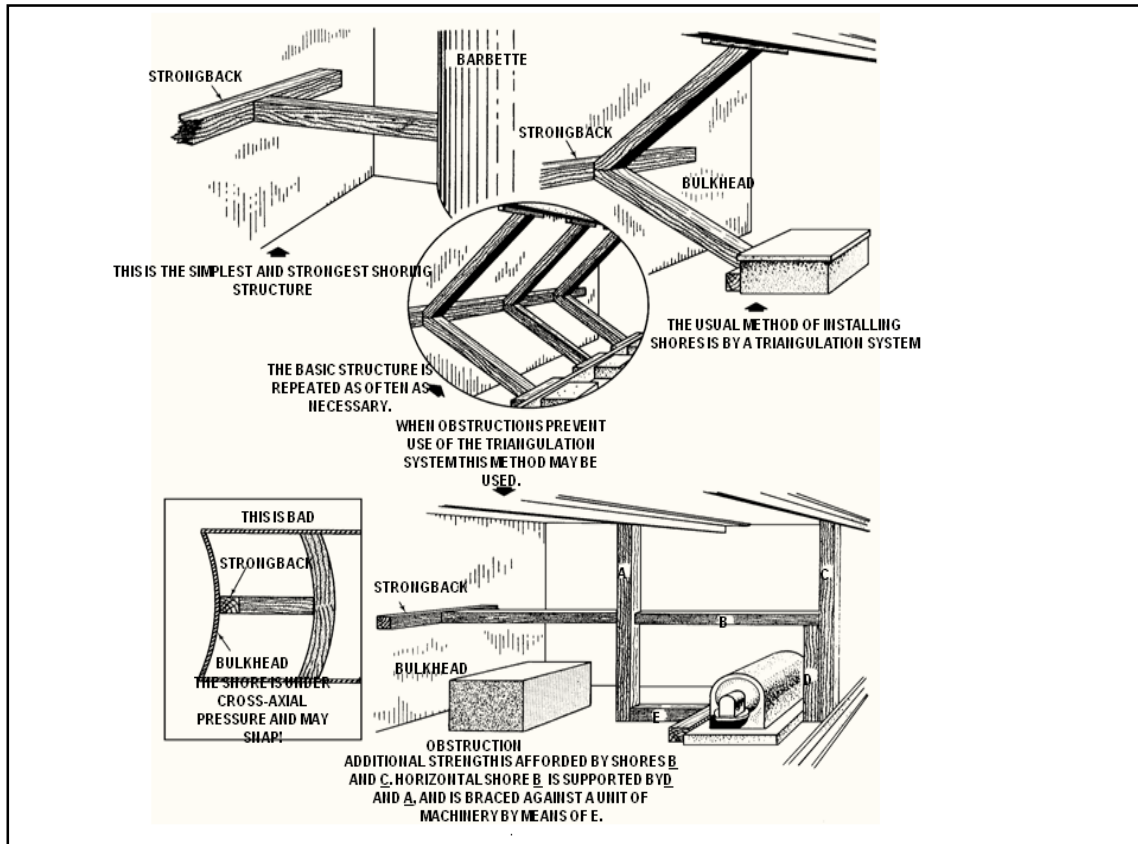
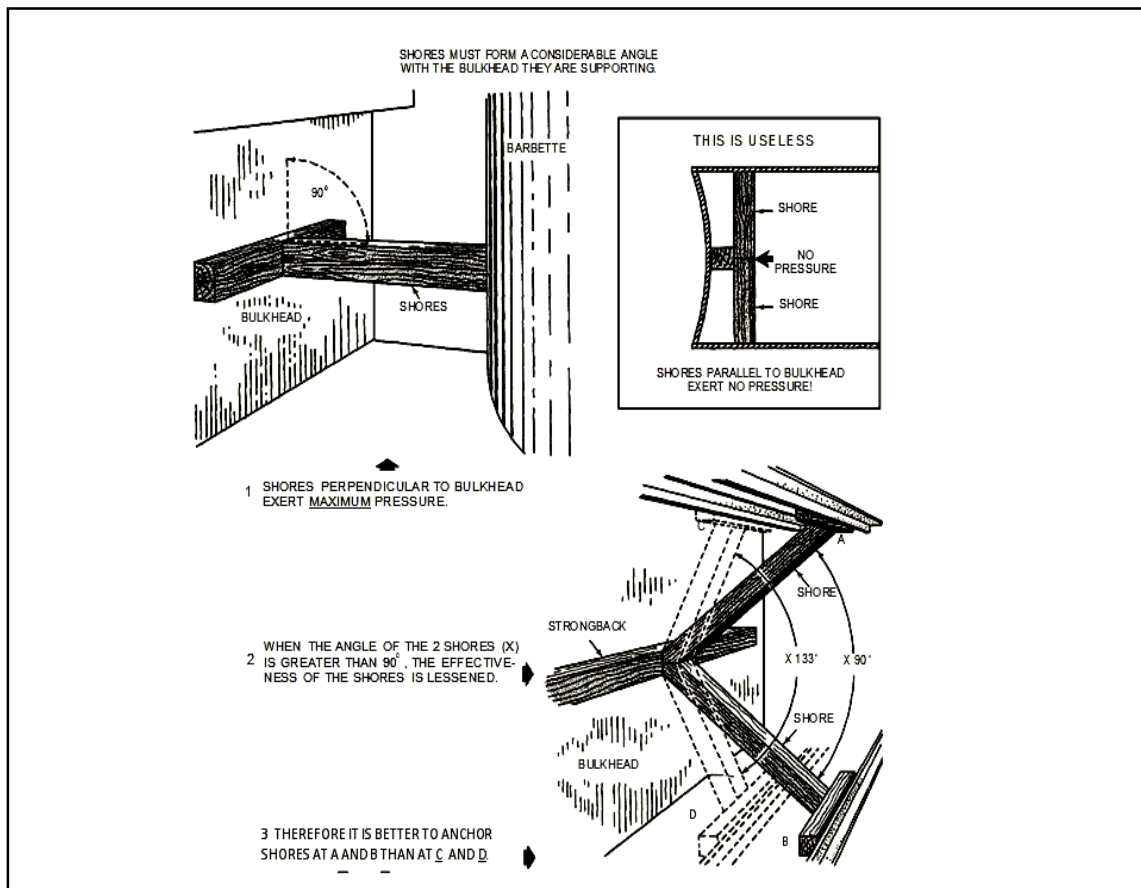


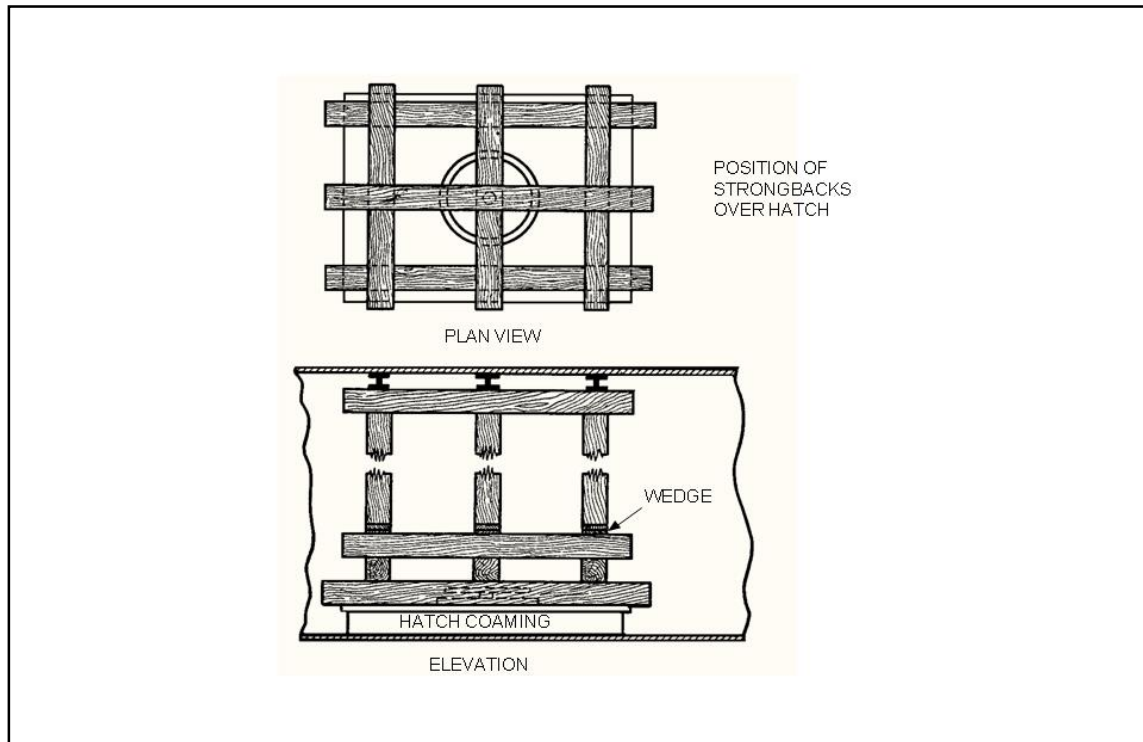
Figure 4-18. Shoring against horizontal pressure



**Figure 4-19. Shoring angles**

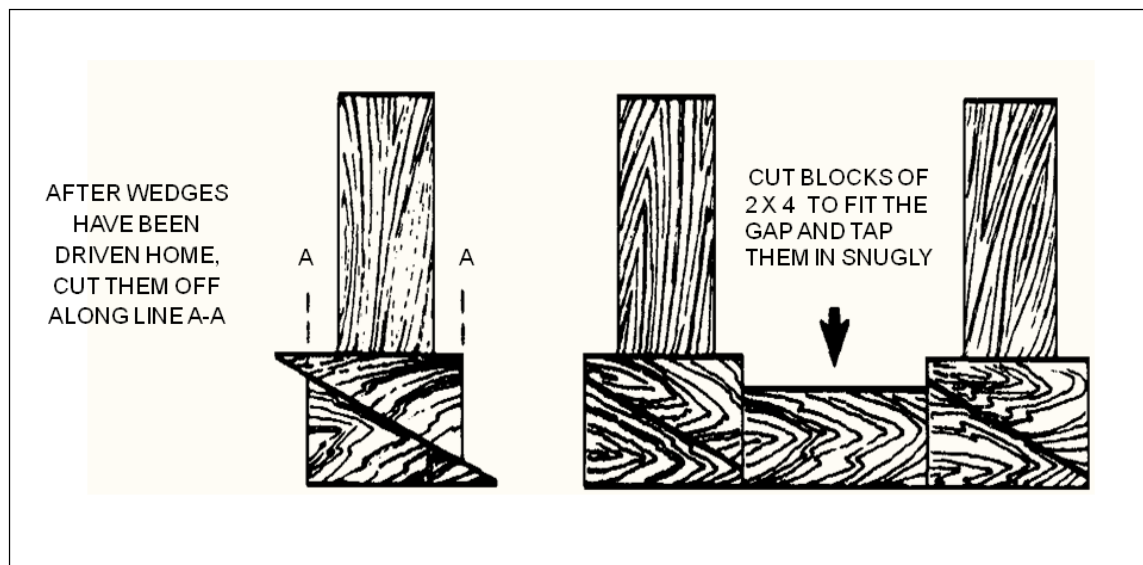
4-63. Do not attempt to force a warped, sprung, or bulged bulkhead back into place. Place the shoring so that it will hold the bulkhead in its warped or bulging position. When possible, strengthen the main shores with auxiliary shores.

4-64. The same general rules apply to shoring a hatch or a door. However, the entire hatch or door should be shored and the pressure should be spread over both the hatch cover or door and the supporting structure, as shown in figure 4-20 on page 4-24. Remember that hatches and doors are the weakest part of the bulkhead or deck in which they are installed. Shoring doors and hatches may be complicated by the presence of scuttles and quick-acting handwheels. In the situation shown in figure 4-19, the shores are arranged in such a way as to clear the handwheel. A basic rule is to put as many points of pressure on the closure as there are dogs on the closure.



**Figure 4-20. Shoring a hatch**

4-65. The success of any shoring job depends largely on the way in which the timbers are wedged. As the shoring job progresses, check carefully to ensure that all of the wedges are exerting about the same amount of pressure on the member being shored. Use as few wedges as possible to obtain satisfactory results. Always drive the wedges in uniformly from both sides so that the shore end will not be forced out of position. Lock the wedges in place so that they will not work loose and cause the shoring to slip. Figure 4-21 shows one method of locking wedges in place.



**Figure 4-21. Locking wedges in place**

4-66. If you are in charge of a shoring detail and if you have enough shores on board, it would be a good idea to give your shoring detail personnel some practice in shoring. As they put up the shoring, explain what they are doing right and what they are doing wrong and, in each case, why it is right or wrong. Ensure that they understand the principles of spreading the pressure, and why a shore in cross-axial pressure might snap. Be sure that they learn how to measure shores and how to cut them correctly before they actually do the cutting. If possible, obtain permission to put the shoring up in a compartment where it may be left for a few days. This will allow other personnel to inspect it and indirectly learn something about how to shore.

4-67. When doing practice shoring jobs, be careful not to cut the shores more than necessary. You will seldom have an oversupply of shores aboard ship. If you do not have spare shores for practice jobs, use strips and battens to build mock-ups and models to scale. Although models are not as effective for training as actual practice shoring jobs, they do have some training effect. An important advantage of models is that you can work out some rather elaborate shoring problems with them. Also, the models can be kept and used again and again for training purposes.

4-68. After the shoring practice has been completed (whether using a model or full-size shores), it is a good idea to have the shoring detail personnel discuss the job and make comments on the good and bad points of the shoring. Some of the questions to be brought up in this discussion include the following:

- Is the shoring job effective?
- Could it be made just as effective with fewer shores?
- Should more shores have been used?
- Is the shoring pressure correctly spread?
- Is the wedging done correctly?

4-69. This type of questioning and discussion can be effective as a device for making sure that everyone involved really understands the problems and principles of shoring.

## SHIP'S MAUL

4-70. The maul is a hand hammer with one flat striking surface and one wedge-shaped end (see figure 4-22). It is used to drive plugs and wedges into holes and cracks in piping and openings as well as for driving wedges into shoring structures. The maul is also used by the shoring watch for pounding shoring wedges and braces back into place should they become loose.

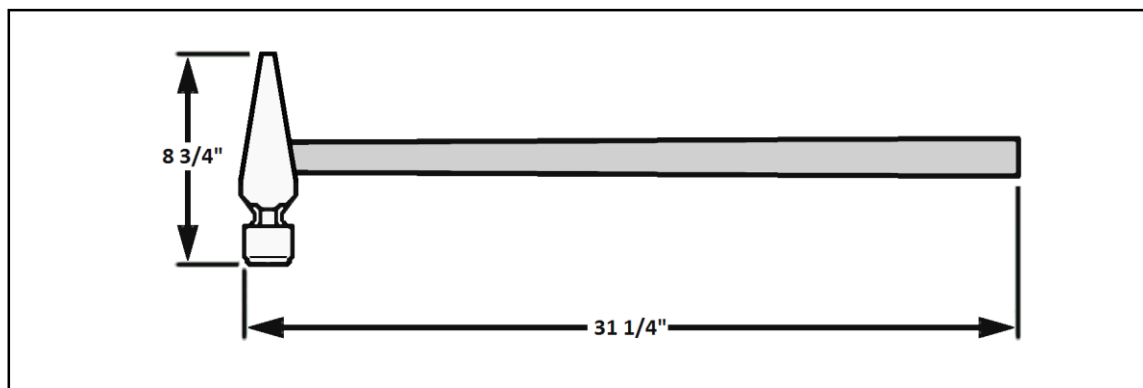


Figure 4-22. Ships maul

## ELECTRIC REPAIR KIT

4-71. The electrical tool kit contains, but is not limited to these items listed below.

- Chisel.
- Pliers.
- Hand Wire Stripper.
- Hacksaws.



- Ball peen hammer.
- Screwdrivers.
- Wrenches.
- Tool belt.
- Fuses.
- Electrical tape.
- Flashlight.
- Line volt indicator.
- Electrical workers gloves.

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**Note.** Electrical tool kits located in damage control lockers are to be used for emergency purposes only.

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4-72. The electrical tool kit is designed to repair faulty circuits providing that the hazardous area has been deemed safe enough to complete the work. After an unplanned event (i.e., an accident) all electrical systems should be thoroughly tested to ensure that further damage to equipment, machinery, or personnel will not arise.

4-73. When making electrical repairs, the following guidelines shall be adhered to by all Army watercraft personnel:

- No personnel at any time shall work on an electrical circuit or system alone.
- Know the potential hazard and use equipment properly.
- Prior to starting work ensure that all circuits of concern are deactivated and tagged out in two separate locations.
- Use a meter to ensure that circuit is de-energized at the source.
- Upon completion of work ensure that all tools are cleaned, in operational condition, and returned to proper storage area.

## **EMERGENCY PIPE PATCHING**

4-74. Damaged piping systems are another source of flooding in compartments. The pipes may have small holes or cracks, or be totally severed. Normally, you will want to isolate the damage by securing the cutout valves on each side of the damaged section of piping. However, whether the piping may be secured, and the amount of time it can be secured, will depend on the service the system provides. A saltwater flushing line may stay secured until repairs can be made after vital repairs have been completed. However, you will need to make temporary repairs on some lines immediately to put the system back into service. Firemain piping, fuel oil lines, and chill water cooling lines to electronic spaces should be repaired as soon as possible.

4-75. Small holes in some piping may be temporarily repaired if you drill the hole out, thread it, and then insert a machine screw. Other holes will require a different means of patching. You may use a jubilee pipe patch, a soft patch, or a metallic pipe patch. The materials for all of these repairs are found in the pipe-patching kit.

4-76. Pipe-patching kits are available in the ship's repair lockers. Each kit contains the following items:

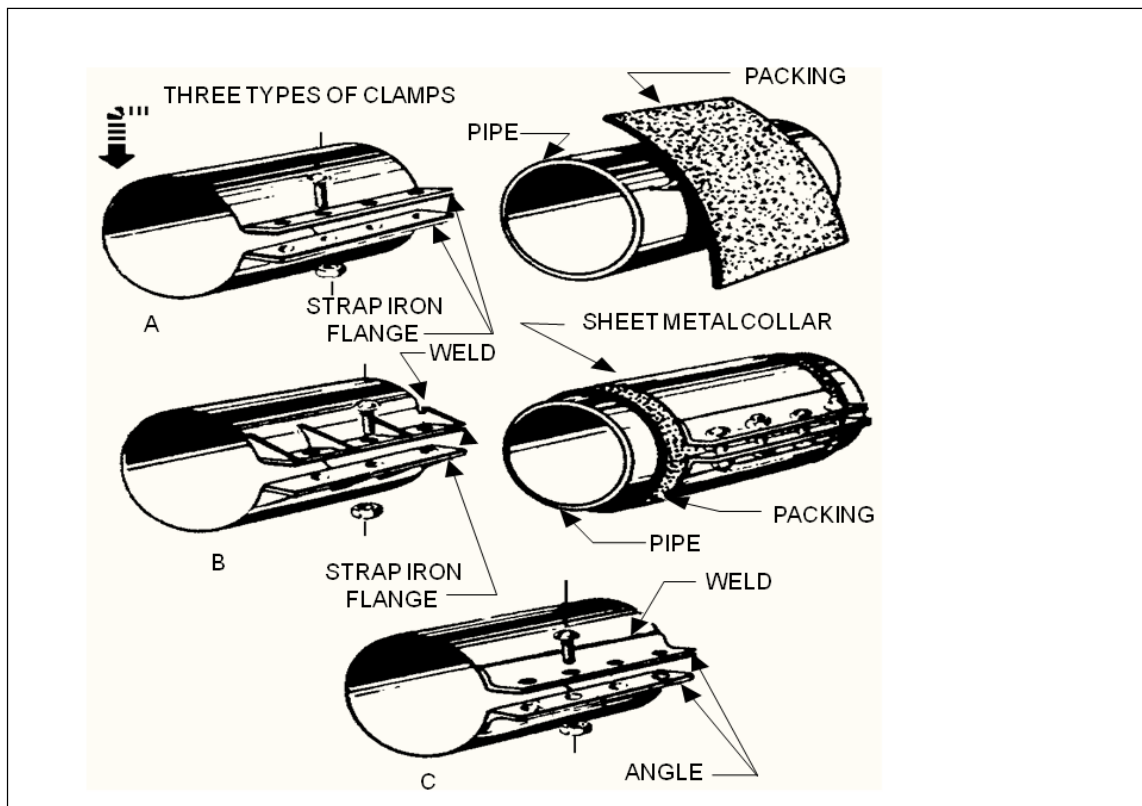
- A canvas bag approximately 30 inches deep and 12 inches in diameter.
- Several small softwood plugs and wedges; enough to plug 24 inches of split.
- Approximately 8 square feet of 1/8-inch rubber gasket.
- Approximately 8 square feet of canvas.
- One hundred and fifty feet of marlin.
- Three pounds of oakum or rags.
- One hacksaw with a minimum of six spare blades.
- One hatchet or wood chisel.
- One hammer; 2 pounds in weight.



- A pair of scissors or a knife for cutting the materials.
- A banding kit.
- Jubilee pipe patches; a minimum of five in various sizes.

### JUBILEE PIPE PATCH

4-77. The jubilee pipe patch shown in figure. 4-23 is a modification of a commercial hose clamp. Periodically, you may purchase heavy-duty jubilee pipe patches through the supply system. However, if you cannot purchase them, you can manufacture them yourself necessary. Do not drive the plugs and wedges in too far or else they will retard the flow of the fluids in the pipe. Once the plugs and wedges are in place, trim them off flush with the outside surface of the pipe. Cover the damaged area with a piece of rubber that will completely cover and extend about 2 inches past the damaged area on all sides. Use two tightly wound layers of marlin or wire to hold the rubber in place.



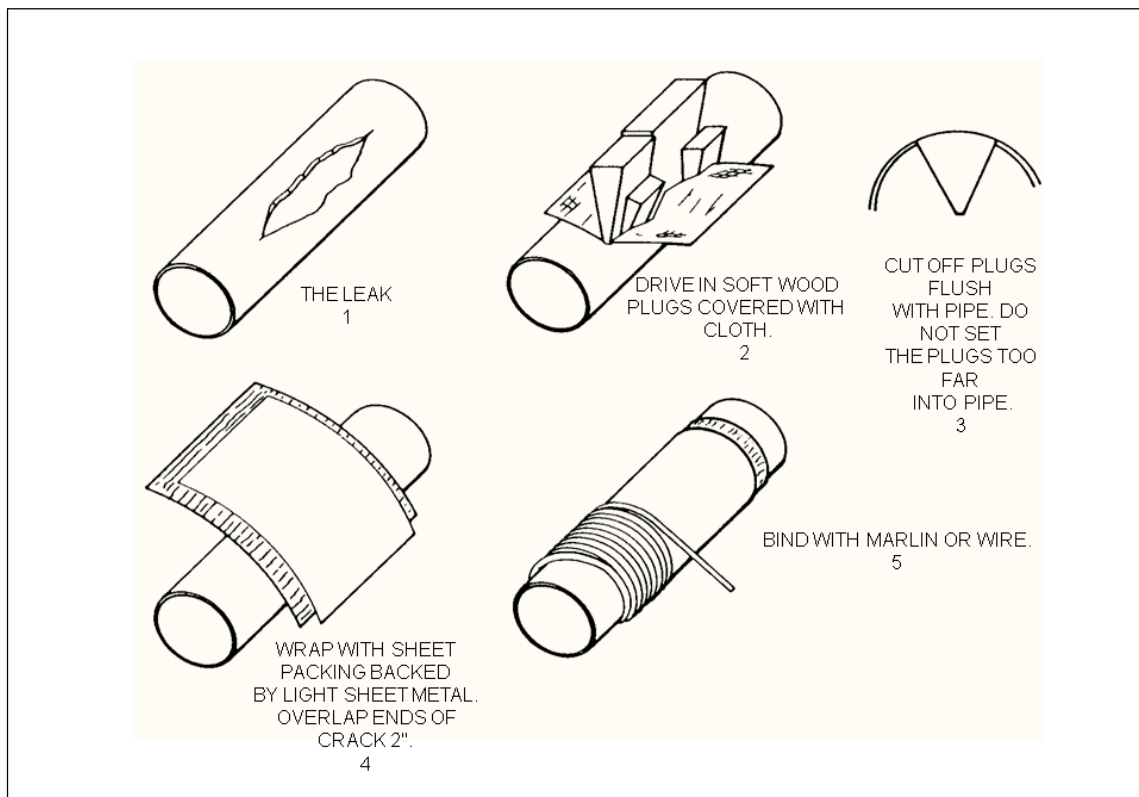
**Figure 4-23. Jubilee pipe patch**

4-78. To manufacture a jubilee pipe patch, roll a piece of sheet metal into a cylinder. Bend a tab on each edge to form a flange. The flanges may be reinforced by welding on strips of scrap iron. Drill three to five holes through both flanges for the securing bolts. To keep the flange faces somewhat parallel when under pressure, weld small braces from the flanges to the back of the patch. Use a thick gauge sheet metal that will withstand pressure but can also be sprung open enough to be put over the pipe.

4-79. To use the jubilee pipe patch, put a piece of rubber or gasket material over the hole. It should be large enough to cover and overlap the damage at least 2 inches on all sides. Slip the jubilee pipe patch over the rubber or gasket material. Insert the bolts into the holes and secure them in place. The jubilee pipe patch can withstand 100 pounds of pressure.

## SOFT PATCH

4-80. Small holes or cracks in low-pressure (150 psi) piping can often be repaired by applying a soft patch (see figure. 4-24). When it is possible, reduce the space created by the hole first by driving in softwood plugs and wedges as necessary. Do not drive the plugs and wedges in too far or else they will retard the flow of the fluids in the pipe. Once the plugs and wedges are in place, trim them off flush with the outside surface of the pipe. Cover the damaged area with a piece of rubber that will completely cover and extend about 2 inches past the damaged area on all sides. Use two tightly wound layers of marlin or wire to hold the rubber in place. The soft patch can be modified or improved to suit the conditions at hand. Often it is advisable to use a curved piece of lightweight sheet metal between the rubber and the marline or wire. A coat of red lead on the face of the rubber will help and you can use marlin and oakum as a caulking material in the cracks.



**Figure 4-24. Soft pipe patch on a low pressure pipe line**

## Emergency Water-Activated Repair Patch (EWARP)

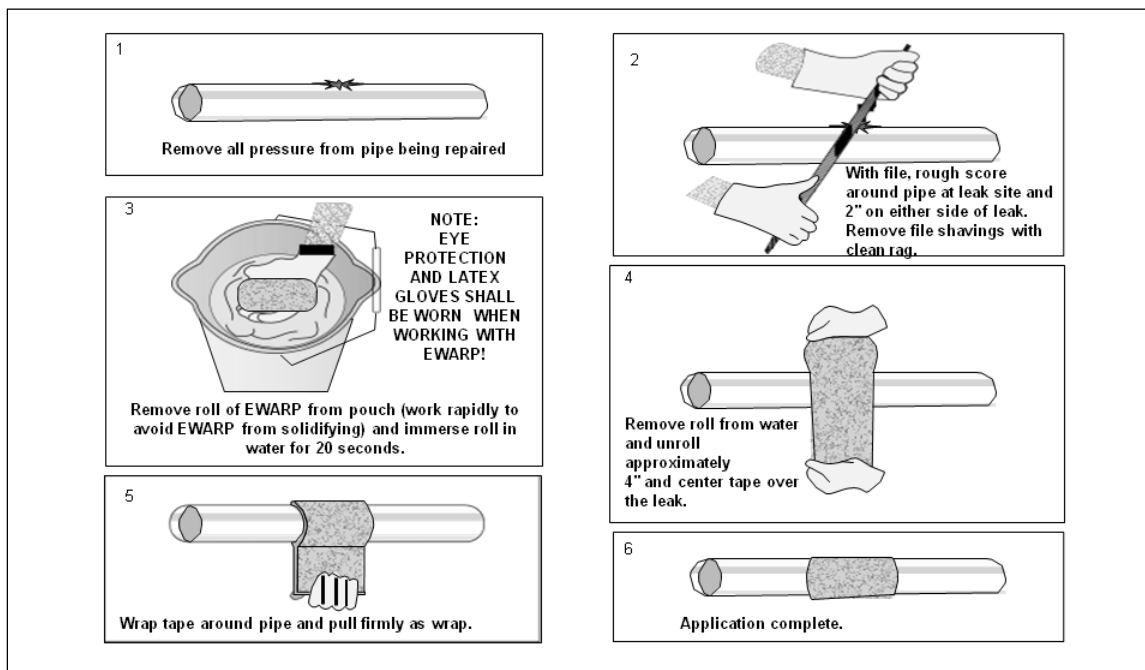
4-81. The Emergency Water-Activated Repair Patch (EWARP) is a unique and easy to use pipe patch that can be used on many piping systems. The EWARP kit and application procedures are shown in figure 4-25 on page 4-29 and figure 4-26 on page 4-30. The EWARP comes in a clear plastic package that includes a foil package containing the instant repair resin coated cloth and a pair rubber gloves. The patch comes in two different sizes; size 1 which is 3 inches by 9 feet and size 2 that is 4 inches by 15 feet. Maximum operating pressure is 150 psi. Normal operating temperature should not exceed 300 degrees Fahrenheit. The syntho-glass patch must be firmly wrapped around the damaged area extending several inches. If needed, the excess can be cut with a knife. The patch can also be sanded and painted. The EWARP is fully hardened in 30 minutes and complete function of the system can be resumed.

**CAUTION**

Do NOT use the Emergency Water-Activated Repair Patch (EWARP) on potable water inlet lines or fuel systems.



**Figure 4-25. Emergency Water-Activated Repair Patch (EWARP) kit**



**Figure 4-26. Emergency Water-Activated Repair Patch (EWARP) application procedures**

4-82. When battle damage occurs, it must be repaired. In most cases, you will make a temporary repair until a permanent repair can be made. Shoring, plugging, and patching are your normal means of making the necessary temporary repairs. If it is possible, you should put this knowledge into practical use with training aids such as a section of pipe that may be connected to a ship's fireplug. And always remember that you should not use expendable materials for training purposes until you have received permission.

## EMERGENCY LIGHTING

4-83. Emergency lighting systems are both fixed and portable. Fixed systems comprise of both installed lighting system, marked with red letter "E", and semi-installed portable lanterns which are also wired directly into the vessel's emergency power system. Portable emergency lighting systems are stand alone, battery operated, lanterns mounted in specific areas throughout the vessel. Portable emergency lighting lanterns, battle lanterns, are marked with "EL" and the station number. Each semi-portable and portable emergency lighting station is labeled with the station number near the station location in addition to being marked on the lantern.

4-84. Emergency lighting and power systems test and inspection requirements are as follows:

- Where fitted, it shall be the duty of the master to see that the emergency lighting and power systems are operated and inspected at least once in each week that the vessel is navigated to be assured that the system is in proper operating condition.
- Internal combustion engine driven emergency generators shall be operated under load for at least two hours, at least once in each month that the vessel is navigated.
- Storage batteries for emergency lighting and power systems shall be tested at least once in each 6-month period that the vessel is navigated to demonstrate the ability of the storage battery to supply the emergency loads for the specified period of time.
- The date of the tests and the condition and performance of the apparatus shall be noted in the official logbook.

## Chapter 5

# Global Maritime Distress and Safety System

The International Maritime Organization (IMO), a United Nations agency specializing in safety of shipping and preventing ships from polluting the seas, were looking at ways of improving maritime distress and safety communications. In 1979, a group of experts drafted the International Convention on Maritime Search and Rescue, which called for development of a global search and rescue plan. This group also passed a resolution calling for development of a Global Maritime Distress and Safety System (GMDSS), to provide the communication support needed to implement the search and rescue plan. This system, which the world's maritime nations, including the United States, have implemented, is based upon a combination of satellite and terrestrial radio services, and has changed international distress communications from being primarily ship-to-ship based to primarily ship-to-shore (Rescue Coordination Center) based. Recently an effort is being made to review the GMDSS in order to modernize the system. This effort will result in adoption of new technology and improved search and rescue.

## GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM SEA AREAS

5-1. GDMSS sea areas have two purposes: to describe areas where GMDSS services are available, and to define what GMDSS ships must carry. The four sea areas are defined below.

### SEA AREA A1

5-2. An area within the radiotelephone coverage of at least one very high frequency (VHF) coast station in which continuous digital selective calling (DSC) (channel70) alerting and radiotelephony services are available, as defined by the International Maritime Organization. The United States presently has no A1 sea areas.

### SEA AREA A2

5-3. An area, excluding Sea Area A1, within the radiotelephone coverage of at least one medium frequency (MF) coast station in which continuous DSC (2187.5 kilohertz (kHz)) alerting and radiotelephony services are available, as defined by the International Maritime Organization. GMDSS-regulated ships travelling this area must carry a DSC-equipped medium frequency (MF) radiotelephone in addition to equipment required for Sea Area A1.

5-4. The United States presently has no declared A2 sea areas. The U.S. Coast Guard has installed and is operating seven A2 sea area-capable coast stations, but those stations do not yet provide continuous coverage. Installation of DSC at most additional A2 Sea Area-capable coast stations is on hold, pending an upgrade to our 2 megahertz (MHz) infrastructure.

### SEA AREA A3

5-5. An area, excluding sea areas A1 and A2, within the coverage of an international maritime satellite (INMARSAT) geostationary satellite in which continuous alerting is available. Ships traveling this area must carry either an INMARSAT F77, B or C ship earth station, or a DSC-equipped high frequency (HF) radiotelephone/telex, in addition to equipment required for an A1 and A2 Area.

## SEA AREA A4

5-6. The area outside that covered by areas A1, A2 and A3 is called Sea Area A4 Area. Ships traveling these Polar Regions must carry a DSC-equipped HF radiotelephone/telex, in addition to equipment required for areas A1 and A2.

## DISTRESS ALERTING

5-7. Distress alerting may be accomplished in three different ways: ship to shore, ship to ship and shore to ship. If terrestrial radio links, rather than satellite, are used, nearby ships will also hear the alert. The initial alert may be sent in a number of ways. The alert may be sent via INMARSAT-C, VHF/FM DSC radio, MF/HF DSC radio or EPIRB. All of these methods give the vessel's identity as well as its location. A DSC alert is the only type that can be picked up by another vessel. It is normally the responsibility of the Rescue Coordination Center (RCC) to respond with an acknowledgement. Vessels at sea should not normally acknowledge receipt of an initial distress alert.

## DISTRESS RELAY

5-8. Once an RCC has heard and acknowledged a distress, it may wish to alert other vessels in the area by means of a distress relay. The relay can be addressed to a precise geographic area so that vessels too far away to render help are not involved. Vessels can be alerted using INMARSAT-C, VHF/FM DSC radio, MF/HF DSC radio or Navigational Telex (NAVTEX). Any vessel receiving a distress alert directly, or a distress relay, must contact the RCC to offer assistance. Vessels at sea should not normally send a distress relay themselves.

## SEARCH AND RESCUE (SAR)

5-9. When the search and rescue (SAR) phase is entered, all communication is two-way to coordinate the activities of ships and aircraft using terrestrial and satellite communication links available. Specific frequencies are allocated for this purpose. Under all circumstances, a shore based RCC takes charge of the operation. The RCC may be located as much as a hemisphere away from the actual casualty. Vessels and aircraft close to the casualty will communicate between themselves using short range terrestrial communications (VHF or MF). Specially designated search and rescue (SAR) radio channels will be used. Precise location of the casualty will be aided by the use of a search and rescue transponder (SART) or the 406 MHz section of a satellite Emergency Position Indicating Radio Beacon (EPIRB). Both of these items may be carried in the life raft. Portable VHF life raft radios are used by survivors to communicate with rescuers on channel 16, and one other channel, usually channel 6.

## RECOMMENDED PUBLICATIONS

5-10. Table 5-1 below and continuing on page 5-3 identifies the recommended publications to be maintained aboard all vessels equipped with GMDSS systems aboard.

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*Note.* This list is not all inclusive, but should be filled as a minimum

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**Table 5-1 Recommended GMDSS publications**

<b><i>Name of publication</i></b>	<b><i>Quantity needed</i></b>
Publication 117 Radio Navigational Aids	1
Merchant Ship Search and Rescue Manual (MERSA)	1

Table 5-1. Recommended GMDSS publications (continued)

<i>Name of publication</i>	<i>Quantity needed</i>
International Maritime Organization (IMO) Search and Rescue Manual (IMSOAR Manual)	1
International Telecommunications Union (ITU)	1
List of Call Signs and Numerical Identities	1
List of Coast Stations	1
Ship Stations (Volumes I, II, III)	1
Title 47 Code of Federal Regulations Part 80	1
Communication Satellite (COMSAT) Users Guide	1
IMO Global Maritime Distress Safety System Operators Guidance for Master of Ships In Distress Placard IMO#969e	2

5-11. The 406 MHz Category I Emergency Position Indicating Beacon (EPIRB) is used aboard Army watercraft for electronic transmission of a data signal that will aid vessel/crew relocation in the event of capsizing, sinking, or abandon ship.

5-12. The 406 MHz Category I EPIRB is constructed of high impact resistant plastics are usually brightly colored. Generally, a four-position switch is incorporated that allows the unit to be armed, tested, disabled, or manually activated. A strobe light and antenna are also incorporated. The EPIRB is stored in a bracket that uses a hydrostatic release unit (HRU) designed to allow automatic float free deployment and activation from the vessel when submerged from a depth of 3 to 10 feet. Manual release and activation is also an option. See figure 5-1 for EPIRB deployment.

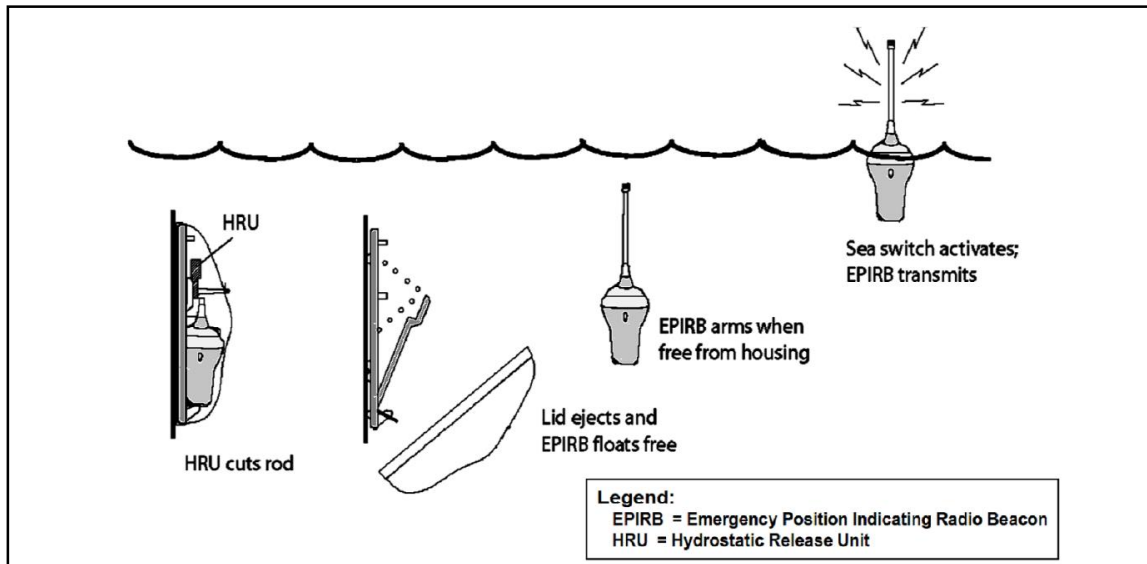


Figure 5-1. EPIRB deployment

## EMERGENCY POSITION INDICATING RADIO BEACON

5-13. The types of Emergency Position Indicating Radio Beacons are defined into the following two categories; I and II.

**Category I**

5-14. 406/121.5 MHZ. Float-free, automatically activated EPIRB. Detectable by satellite anywhere in the world. Recognized by GMDSS.

**Category II**

5-15. 406/121.5 MHZ. Similar to Category I, except is manually activated. Some models are also water activated.

**406 MHz EPIRBs**

5-16. The 406 MHz EPIRB was designed to operate with satellites. The signal frequency (406 MHz) has been designated internationally for use only for distress. Other communications and interference, such as on 121.5 MHz, is not allowed on this frequency. Its signal allows a satellite local user terminal to accurately locate the EPIRB (much more accurately -- 2 to 5 km vice 25 km -- than 121.5/243 MHz devices), and identify the vessel (the signal is encoded with the vessel's identity) anywhere in the world (there is no range limitation). These devices are detectable not only by Cosmitcheseskaja Sistema Poiska Awarinitsch Sudow (COSPAS)-Search and Rescue Satellite Aided Tracking (SARSAT) satellites which are polar orbiting, but also by Geostationary Operational Environmental Satellite (GOES) weather satellites. EPIRBs detected by the Geostationary Synthetic Thinned Aperture Radiometer (GeoSTAR) system, consisting of GOES and other geostationary satellites, send rescue authorities an instant alert, but without location information unless the EPIRB is equipped with an integral GPS receiver. EPIRBs detected by COSPAS-SARSAT (e.g. TIROS N) satellites provide rescue authorities location of distress, but location and sometimes alerting may be delayed as much as an hour or two. These EPIRBs also include a 121.5 MHz homing signal, allowing aircraft and rescue craft to quickly find the vessel in distress. These are the only type of EPIRB which must be certified by Coast Guard approved independent laboratories before they can be sold in the United States.

5-17. The 406 MHz EPIRB, has an integral GPS navigation receiver that is recommended by the U.S. Coast Guard. A properly installed Category I, automatically activated EPIRB is the most preferred. This EPIRB will send accurate location as well as identification information to rescue authorities immediately upon activation through both geostationary (GEOSAR) and polar orbiting satellites.

5-18. The major advantage of the 406 MHz low earth orbit system is the provision of global Earth coverage using a limited number of polar-orbiting satellites. Coverage is not continuous, however, and it may take up to a couple of hours for an EPIRB alert to be received. To overcome this limitation, COSPAS-SARSAT has 406 MHz EPIRB repeaters aboard three geostationary satellites, plus one spare: GOES-W, at 135 deg W; GOES-E, at 75 deg W; INSAT-2A, at 74 deg E; and Indian National Satellite (INSAT)-2B (in-orbit spare), at 93.5 deg E. Ground stations capable of receiving 406 MHz, except for areas between the United Kingdom and Norway, south of the east coast of Australia, and the area surrounding the Sea of Okhotsk near Russia, as well as polar areas, GEOSAR provides continuous global coverage of distress alerts from 406 MHz EPIRBs.

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**Note.** The GEOSAR cannot detect 121.5 MHz alerts, nor can it route unregistered 406 MHz alerts to a rescue authority. GEOSAR cannot calculate the location of any alert it receives, unless the beacon has an integral GPS receiver.

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***The COPAS-SARSAT System***

5-19. COSPAS-SARSAT is an international satellite-based search and rescue system established by the U.S., Russia, Canada and France to locate emergency radio beacons transmitting on frequencies 121.5, 243 & 406 MHz

***COSPAS***

5-20. Space System for Search of Distress Vessels (a Russian acronym).



## **SARSAT**

### 5-21. Search and Rescue Satellite-Aided Tracking.

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**Note.** For more information on the COSPAS-SARSAT System go to their web site which is provided in the references section in the back of this manual.

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## **TESTING EPIRBs**

5-22. 406 MHz EPIRBs can be tested through its self-test function, which is an integral part of the device. 406 MHz EPIRBs can also be tested inside a container designed to prevent its reception by the satellite. Testing a 406 MHz EPIRB by allowing it to radiate outside such a container is illegal.

## **BATTERY REPLACEMENT**

5-23. Batteries must be replaced by the date indicated on the EPIRB label using the model specified by the manufacturer. It should be replaced by a dealer approved by the manufacturer. If the replacement battery is not the proper type, the EPIRB will not operate for the duration specified in a distress.

## **REGISTRATION OF 406 MHZ EPIRBs**

5-24. Proper registration of your 406 MHz satellite EPIRB is intended to save your life, and is mandated by Federal Communications Commission (FCC) regulations. The U. S. Coast Guard is enforcing this FCC registration rule.

5-25. ALARACT 294/2010-2010 mandates that ALL Army watercraft and their parent commands register their EPIRBs with the Joint Search and Rescue Satellite-Aided (SARSAT) Electronic Tracking System (JSETS) Personnel Recovery Mission Software (PRMS). The National Oceanic Atmospheric Administration (NOAA) is no longer providing service to Army watercraft EPIRBs. Failure to register EPIRBs with JSETS/PRMS will subject vessel crews to dangerous situations due to non-notification status.

### **WARNING**

**Any EPIRB that is currently registered with the NOAA, MUST also be registered in JSETS**

5-26. Registering EPIRBs with JSETS/PRMS is a four step process which are; creating a JSETS/PRMS account, verifying personal information with PRMS, requesting appointment for access to JSETS/PRMS, and finally, receive appointment role/access and start inputting EPIRB(s) data and managing EPIRB(S) using JSETS/PRMS. Paragraphs 5-27 through 5-30 provide detailed step-by-step instructions for registering EPIRBs with JSETS/PRMS.

5-27. Step one. Create JSETS/PRMS account. Create a JSETS/PRMS account for the appropriate level (unit manager, point of contact, or recovery coordinator) by launching the PRMS web site. The link to the PRMS web site can be found in the reference section in the back of this manual.

5-28. Step two. Verify personal information with PRMS. After JSETS/PRMS account is created, the individual will receive an auto-generated email from PRMS which requires the individual to contact the PRMS helpdesk at one of the following phone numbers; commercial, 586-239-3701 or Defense Switched Network (DSN) 312-273-3701. This contact with the helpdesk will confirm the information on the JSETS account.

5-29. Step three. Once the information has been verified, PRMS will initiate a second email with the appropriate appointment memorandum of unit manager, point of contact, or recovery coordinator. This memorandum requires commander/supervisor approval for access/management of radio beacon(s) within JSETS. Once the commander or supervisor has provided the information required in the memorandum, it is sent via email to the PRMS mailbox or by fax to commercial, 586-239-3715 or DSN, 312-273-3715. The

PRMS mailbox address is provided in the reference section in the back of this manual. Upon receipt of memorandum information, PRMS will update access on the requested account and send a confirmation email to the applicant when this action is completed.

5-30. Step four. The applicant will receive a final email from PRMS granting access to JSETS. This approval email will appoint the applicant as the unit manager, recovery coordinator, or other access role such as point of contact.

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**Note.** The role of unit manager is mainly for detachments and units. The role of recovery coordinator would be for Brigade or Sustainment Commands.

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5-31. Additional contact information for SARSAT Beacon registration is provided in the note below.

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**Note.**

SARSAT BEACON REGISTRATION  
Database login at <https://prmsglobal.prms.af.mil>  
Operations Support Team  
Commercial Phone: 586-239-3701  
Defense Switched Network (DSN) Phone: 312-273-3701  
Email address: [prmsmail@enclave.ircp.osis.gov](mailto:prmsmail@enclave.ircp.osis.gov)

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## **SURVIVAL CRAFT RADIO**

5-32. The 16/6 life raft radio is a portable two-way radiotelephone used for on-scene emergency communications between survival craft and rescue units. The radio is equipped with a five year lithium battery pack, which is operator replaceable. The radio will operate on channel 16 and one other channel designated for Search and Rescue, usually channel 6. The radio is the Federal Communications Commission (FCC) type accepted and GMDSS listed (FCC Part 80.1101) as a survival craft two-way VHF radiotelephone apparatus which complies with the 1988 GMDSS SOLAS amendments. The life raft radio should be tested semi-annually using a battery other than the assigned life raft radio battery. Three life raft radios are installed on the vessel.

### **DESCRIPTION**

5-33. GMDSS Survival Craft Radio (SCR) is a portable, two-way VHF transceiver capable of radiotelephone communication. The equipment is capable of being utilized for on-scene communications between survival craft and rescue units. It may also be used between survival craft and the ship in distress, and for on-board communications when equipped with appropriate working channels. See figure 5-2 on page 5-7.



**Figure 5-2. Survival Craft Radio (SCR)**

### **PERFORMANCE STANDARDS**

5-34. SCRs must meet IMO performance standards. The equipment is comprised of an integral transmitter, receiver (with push-to-talk switch), battery and antenna. A built-in microphone and speaker provides transmit and receive audio to the transceiver.

5-35. SCRs should be capable of withstanding drops onto a hard surface from a height of at least one (1) meter. Their watertight integrity must be maintained to a depth of one (1) meter for a period of at least five (5) minutes. SCRs have a lanyard or wrist strap which serves as an attachment to the user or his clothing.

### **EMISSION AND CHANNELS**

5-36. SCRs must operate on 156.800 MHz (VHF channel 16) and at least one additional channel. This additional channel is often 156.300 MHz (VHF channel 06) because it is designated as an on-scene, Search and Rescue frequency. Most SCRs use phase modulation designation code of G3E in lieu of true Frequency Modulation (FM). The G3E code for the SCR is an internationally way of describing the essential characteristics of the SCR frequency transmission.

5-37. A number of commercially available SCRs operate on all VHF channels in the marine band. This permits the transceiver to meet the special demands of GMDSS and still meet daily operational requirements. All channels fitted are capable of single frequency voice communications.

### **BATTERY REQUIREMENTS**

5-38. A number of SCRs use rechargeable NiCad batteries for day-to-day operations and a non-rechargeable lithium battery pack for maritime safety applications. The batteries are integrated into the transceiver. They must have sufficient capacity to ensure a minimum of 8 hours of operation at the SCRs highest radio frequency (RF) power output.

5-39. Many of the newer model SCRs has batteries that may be replaced by the user. For batteries used for survival craft equipment, the month and year of its manufacture must be permanently marked on the battery. Also, the month and year upon which 50 percent of its useful life will expire must be permanently marked on both the battery and the outside of the transceiver.

5-40. Batteries must be replaced if 50% of their useful life has expired or if the transmitter has been used in an actual emergency situation. Batteries must be replaced on or before the expiration date, there is no grace period.

### **TRANSMITTER SPECIFICATIONS**

5-41. The SCR must be capable of radiating a minimum RF power of 250 megawatt (mw) (.25 watts) Many SCR transmitters are designed to produce 500 mw of power. If the transceiver is capable of producing RF power levels in excess of 1 watt, a power reduction switch must be provided to reduce drain on the battery. The power reduction switch must reduce RF transmitter power to 1 watt or less.

### **ANTENNA**

5-42. SCR antennas must be vertically polarized. They should be tuned for maximum range and omnidirectional in the horizontal plane. Some SCR manufacturers include a reflective tip on the antennas which may be used to attract the attention of rescue personnel.

### **CARRIAGE REQUIREMENTS**

5-43. At least 3 two-way VHF survival craft radios must be provided on every passenger ship and cargo ships of 500 gross tonnage and upwards. At least 2 two-way VHF survival craft radios must be provided on every cargo ship between 300-500 tons gross tonnage.

### **STOWAGE REQUIREMENTS**

5-44. GMDSS SCRs must be stowed in such locations that they can be rapidly placed in any survival craft (other than life rafts required by the SOLAS convention). SCRs may be fitted as a fixed two-way VHF radiotelephone installation in survival craft. Such installations must adhere to the same performance standards of the portable SCR identified above.

### **TESTING REQUIREMENTS**

5-45. Survival craft radios must be tested at intervals not to exceed 12 months.

### **SEARCH AND RESCUE TRANSPONDER**

5-46. The search and rescue transponder (SART) is a battery powered transponder used in an emergency by survivors of sinking Army vessels. The SART must be mounted in the life raft one meter above the sea. The signal from the SART is detected by 9 gigahertz (GH) (3 cm) radar at a range of five to seven miles using the ship's radar. Aircraft radar can receive the SART signal flying at 3,000 feet at up to 40 nautical miles. Once activated, the SART will rebroadcast a response to a 3cm radar interrogation. At the same time, a line of 12 dots will appear on the search radar screen, radiating outwards from the position of the SART. Once the

search vessel or aircraft has approached within one nautical mile of the SART, these dots widen to eventually form a series of concentric circles around the position of the SART. The SART has a built-in test capability and should be tested monthly. Two SARTs are installed on the vessel.

## **DESCRIPTION**

5-47. GMDSS SARTs are portable devices capable of transmitting locating signals which indicate the location of a mobile unit in distress. The SART signal is picked up by the rescue unit's X-band, 9 gigahertz (GHz), 3 cm Navigational RADAR. The SART signal appears on the RADAR display as a series of equally spaced dots radiating outward on a line of bearing.

## **GENERAL**

5-48. SARTs are the primary terrestrial means of providing locating signals in the GMDSS. They respond to interrogation by 3 cm, X-Band Radar from surface search vessels or aircraft.

## **ACTIVATION**

5-49. SARTs are typically carried into survival craft and activated manually. SARTs are required to be capable of manual activation and deactivation. Provisions for automatic activation are also permitted. When activated from a ship in distress or survival craft, SARTs provide an audible and / or visual indication, to indicate proper operation, and to alert survivors whenever the RADAR has triggered the SART.

5-50. This indication should encourage survivors by letting them know rescue units are in the area. It also signals an appropriate time for survivors to attract the attention of rescue units via secondary alerting devices (e.g., SCT VHF Radio or pyrotechnics).

## **BATTERY CAPACITY**

5-51. SARTs must have sufficient battery capacity to last for 96 hours in the standby mode followed by 8 hours in the transponder mode. The receiver has state of the art sensitivity to detect weak radar signals from search units. A SART antenna is typically horizontally polarized and Omni-directional. Some SARTs may have a desiccant cartridge or humidity indicator to detect if the unit's watertight integrity has been violated.

## **COMMUNICATIONS RANGE**

5-52. Because SARTs rely upon direct wave propagation, their communications range is primarily determined by transmitter power output, receiver sensitivity and antenna height above ground. There is little affect a SART operator can have on the first two parameters, however, maintaining the SART as high as possible will optimize its effective range. Some SART manufacturers have included an extension mast to enable survivors to elevate the unit's antenna. The height of an installed SART antenna should be at least 1 meter above sea level.

## **PERFORMANCE STANDARDS**

5-53. IMO performance standards for SART calls for a range of at least 5 miles when a SART is located 1 meter above sea level. This assumes the search vessel has a radar antenna 15 meters high in accordance with IMO requirements. An aircraft at an altitude of 3000 feet should be able to detect a SART at ranges up to 40 nautical miles (NM). The polar diagram of the SART antenna, its Omni-directional pattern and horizontal polarization are designed to optimize communications range, even in heavy swell conditions.

5-54. Most SARTs currently on the market are not designed to float free or be placed in the water, although IMO performance standards require SARTs to be capable of floating if not an integral part of a survival craft. SARTs are required to sustain a drop from 20 meters into the water without damage, and maintain watertight integrity to a depth of 10 meters for a period of at least 5 minutes.

## **CARRIAGE REQUIREMENTS**

5-55. At least one radar transponder must be carried on every cargo ship of three hundred to five hundred gross tons and two radar transponders (one on each side) for every passenger ship and every cargo ship of 500 gross tons and upwards.

5-56. SARTs must be stowed in such locations that they can be rapidly placed in any survival craft.

## **NAVIGATIONAL TELEX**

5-57. Navigational Telex (NAVTEX) is an international automated direct printing service for the promulgation of navigational and meteorological warnings and urgent information to ships. It provides a low cost, simple means for the automatic reception of Marine Safety Information (MSI) by narrow band direct-printing telegraphy. NAVTEX is a component of the World Wide Navigational Warning Service (WWNWS) and is an essential element of the Global Maritime Distress and Safety System (GMDSS). Vessels regulated by the Safety of Life at Sea (SOLAS) Convention, as amended in 1988 (cargo vessels over 300 tons and passenger vessels, on international voyages), and operating in areas where NAVTEX service is available, have been required to carry NAVTEX receivers since 1 August 1993. The USCG discontinued broadcasts of safety information over MF Morse frequencies on that date. The USCG voice broadcasts (Ch. 22A), often of more inshore and harbor information, will remain unaffected by NAVTEX. A NAVTEX placard is intended to be laminated and either hung or posted near the NAVTEX receiver. Refer to National Geospatial Intelligence Agency Publication 117, Radio Navigational Aids for instructions.

## **NAVTEX FEATURES**

5-58. NAVTEX messages are broadcast on a single frequency, 518 kHz, using the English language. Nominated stations within each navigational area (NAVAREA) transmit on a time-sharing basis to eliminate mutual interference. All necessary information is contained in each transmission. The power of each transmitter is regulated in order to avoid the possibility of interference between transmitters. A dedicated NAVTEX receiver has the ability to select messages to be printed according to a technical code (B1B2B3B4) which appears in the preamble of each message; and whether or not the particular message has already been printed.

5-59. By International agreement, certain essential classes of safety information such as navigational and meteorological warnings and search and rescue information are unable to be rejected to ensure that ships using NAVTEX always receive the most vital information. NAVTEX coordinators exercise control of messages transmitted by each station according to the information contained in each message and the geographical coverage required. Therefore, the mariner may choose to accept messages, as appropriate, either from the single transmitter which serves the sea area around his position or from a number of transmitters.

## **MESSAGE PRIORITIES**

5-60. Three message priorities are used to dictate the timing of the first broadcast of a new warning in the NAVTEX service. In descending order of urgency they are:

- VITAL—for immediate broadcast, subject to avoiding interference of ongoing transmissions
- IMPORTANT—for broadcast at the next available period when the frequency is unused
- ROUTINE—for broadcast at the next scheduled transmission period

5-61. Both VITAL and IMPORTANT warnings will normally need to be repeated, if still valid, at the next scheduled transmission period.

## **NAVTEX MESSAGE SELECTION**

5-62. Every NAVTEX message is preceded by a four character header B (1) B (2) B (3) B (4). B (1) is an alpha character identifying the station, and B (2) is an alpha character used to identify the subject of the message. Receivers use these characters to reject messages from stations or concerning subjects of no interest to the user. B (3) and B (4) are a two-digit number identifying individual messages, used by receivers to keep

already received messages from being repeated. For example, a message preceded by the characters FE01 from a U.S. NAVTEX Station indicates that this is a weather forecast message from Boston MA.

### TRANSMITTER IDENTIFICATION CHARACTER (B1)

5-63. The transmitter identification character B1 is a single unique letter which is allocated to each transmitter. See table 5-2 for NAVTEX stations in the U.S. and their corresponding call sign. This identification character is used to identify the broadcasts which are to be accepted or rejected by the receiver. Two stations having the same B1 character must have a sufficient geographical separation so as to minimize interference with one another. NAVTEX transmissions have a designed range of about 400 nautical miles.

**Table 5-2. Navigational Telex (NAVTEX) Stations in the U.S. B (1) Characters**

<b>B (1) Character</b>	<b>Station</b>	<b>Starting Time</b>	<b>Call Sign</b>
F	Cape Cod MA	0045Z	NMF
N	Chesapeake VA	0130	NMN
E	Savannah GA	0040	keyed by NMN
A	Miami FL	0000	NMA
R	San Juan PR	0200	NMR
G	New Orleans LA	0300	NMG
C	Pt Reyes CA	0000	NMC
Q	Cambria CA	0045	NMQ
W	Astoria OR	0130	NMW
J X	Kodiak AK	0300 340	NOJ
O	Honolulu HI	0040	NMO
V	Guam	0100	NRV

*Note.* Until a planned new automatic broadcast scheduler is installed, Miami's starting time of 0000 will be delayed approximately 5 minutes.

Kodiak also broadcasts safety information during slots previously allocated to Adak.

### SUBJECT INDICATOR CHARACTERS (B2)

5-64. Information in the NAVTEX broadcast is grouped by subject. The subject indicator character B2 is used by the receiver to identify the different classes of messages (see table 5-3 below and continuing on page 5-12). The indicator is also used to reject messages concerning certain optional subjects which are not required by the ship (e.g., LORAN-C messages might be rejected in a ship which is not fitted with a LORAN-C receiver –Loran C has been phased out). Receivers also use the B (2) character to identify messages which, because of their importance, may not be rejected (as designated by an asterisk).

**Table 5-3. NAVTEX Broadcast subject indicator characters (B2)**

<b>Indicator</b>	<b>Subject</b>
A	Navigational warnings (1)
B *	Meteorological warnings (1)
C	Ice reports
D	Search & Rescue information and pirate warnings (1)
E	Meteorological forecasts
F*	Pilot service messages
G*	DECCA messages

**Table 5-3. NAVTEX Broadcast subject indicator characters (B2) (continued)**

<b>Indicator</b>	<b>Subject</b>
H	LORAN messages
I	OMEGA messages (note. OMEGA has been discontinued)
J	SATNAV messages (i.e. GPS or GLONASS)
L	Navigational warnings (Additional to A above) (2)
V	Notice to Fishermen (U.S. only – currently not used)
W	Environmental (U.S. only – currently not used)
X to Y	Special services – allocation by IMO NAVTEX Panel
Z	No message on hand
1. Cannot be rejected by receiver	
2. Should not be rejected by receiver	
* Normally not used in the U.S.	

**Note.** Since the National Weather Service normally includes meteorological warnings in forecast messages, meteorological warnings are broadcast using the subject indicator character E. U.S. Coast Guard District Broadcast Notices to Mariners affecting ships outside the line of demarcation, and inside the line of demarcation in areas where deep draft vessels operate, use the subject indicator character A. Two subject indicator characters for non-MSI messages in the United States were established 1 October 1995, but currently are not in use: V for Notice to Fisherman and W for Environmental messages.

### MESSAGE NUMBERING (B3B4)

5-65. Each message within a subject group is assigned a two-digit serial number, B3B4, between 01 and 99. This number will not necessarily relate to series numbering in other radio navigational warning systems. On reaching 99, numbering should restart at 01 but avoid the use of message numbers still in force.

### TECHNICAL INFORMATION

5-66. All NAVTEX broadcasts are made on 518 kHz, using narrow-band direct printing 7-unit forward error correcting (FEC or Mode B) transmission. This type of transmission is also used by amateur teleprinting over radio (AMTOR) service. Broadcasts use 100 baud FSK modulation, with a frequency shift of 170 Hz. The center frequency of the audio spectrum applied to a single sideband transmitter is 1700 Hz. The receiver 6 decibel bandwidth should be between 270-340 hertz.

5-67. Each character is transmitted twice. The first transmission (DX) of a specific character is followed by the transmission of four other characters, after which the retransmission (RX) of the first character takes place, allowing for time-diversity reception of 280 milliseconds (ms).

**Note.** For more information, see International Telecommunications Union (ITU) Recommendations M.540-2 and M.476-5. These recommendations are available from the ITU radio communications sector web site which is located in the references section in the back of this manual.

### PRACTICAL INSTRUCTIONS FOR THE USE OF A NAVTEX RECEIVER

5-68. The NAVTEX receiver is a Narrow Band Direct Printing (NBDP) device operating on the frequency 518 kHz (some equipment can also operate on 490 and 4209.5 kHz), and is a vital part of the Global Maritime Distress and Safety System (GMDSS).



5-69. It automatically receives Maritime Safety Information such as Radio Navigational Warnings, Storm/Gale Warnings, Meteorological Forecasts, Piracy Warnings, and Distress Alerts (full details of the system can be found in IMO Publication IMO-951E - The NAVTEX Manual).

5-70. The information received is printed on the receiver's own paper recorder roll. Each message begins with a start of message function (ZCZC) followed by a space then four B characters. The first, (B1), identifies the station being received, the second, (B2), identifies the subject i.e. Navigational Warning, Met Forecasts, and the third and fourth, (B3 + B4), form the consecutive number of the message from that station. This is followed by the text of the message and ends with an end of message function (NNNN).

5-71. The NAVTEX system broadcasts COASTAL WARNINGS that cover the area from the Fairway Buoy out to about 250 nautical miles from the transmitter; the transmissions from some transmitters can be received out to 400 nautical miles and even further in unusual propagation conditions.

5-72. The practical advice in paragraph 5-73 will help to ensure that you make the most efficient use of your NAVTEX receiver, guaranteeing the reception of Maritime Safety Information within the respective coverage areas of the NAVTEX stations being used.

### NAVTEX RECEIVER CHECK-OFF LIST

5-73. For a NAVTEX receiver to function effectively, it is essential that the operator should have a sound knowledge of how to program and operate his particular receiver. This is not difficult provided the following practical steps are followed:

- Make sure that there are sufficient rolls of NAVTEX paper on board.
- Check that there is paper in the receiver.
- Turn the NAVTEX receiver on at least four hours before sailing, or better still, leaves it turned on permanently. This avoids the chance of losing vital information that could affect the vessel during its voyage.
- Make sure that the equipment operating manual is available close to the equipment, paying particular attention to the fact that your equipment may be programmed differently from other makes and models.
- Using the Equipment Operating Manual, make a handy guide for programming, status and auto-testing procedures for your vessel's equipment, place it in a plastic cover and keep it with the equipment.
- Have available next to the equipment a plasticized copy of the NAVAREA's / meteorological areas (METAREA) in which the vessel is likely to sail, showing the NAVTEX stations, their coverage ranges, their respective time schedules and B1 characters.
- Program your receiver to accept only those messages identified with the B1 character of the NAVTEX station which covers the area in which your vessel is currently sailing and the one covering the area into which you are about to sail. This will avoid the equipment printing information which has no relevance to your voyage and will avoid unnecessary waste of paper.
- Program your receiver to accept only those messages identified with the B2 characters (type of message) you wish to receive. It is recommended that most B2 characters (A to Z) be programmed, but you may exclude those for Navigational Aid System (NAVAIDS) equipment (Decca or Loran for example) with which your vessel is NOT fitted. Be aware that the characters A, B and D MUST be included, as they are mandatory.
- Take extra care not to confuse the programming of B1 characters (station designators) with those of B2 characters (type of messages). It is very easy for an operator to believe that he/she is programming B1 characters when in fact they are programming B2 characters. After programming ALWAYS CHECK the program status to ensure that it is correct.
- If information is received incomplete/garbled, inform the relevant NAVTEX station, giving the time of reception (UTC) and your vessel's position. By so doing, not only will you obtain the information you require, but you will also help to improve the system. In the same way, any safety-critical occurrences observed during the voyage must be passed immediately to the nearest (or most convenient) Coast Radio Station and addressed to the relevant NAVAREA/METAREA or National Coordinator responsible for the area in which you are sailing.

## INTERNATIONAL MARITIME SATELLITE ORGANIZATION

5-74. International Maritime Satellite (INMARSAT) organization pioneered and developed global satellite communications. When INMARSAT began service in 1982 (with the Standard A system), its goal was to provide communications for commercial and distress and safety applications for ships at sea.

5-75. INMARSAT grew out of an initiative of the International Maritime Consultative Organization (IMCO), now the International Maritime Organization (IMO). At the time, mobile satellite communications was an unexplored technology and the industry an embryonic, untested one. So it was decided that INMARSAT should be a joint co-operative venture of governments, with their signatories (nominee organizations), in most cases the country's post and telecommunications providers, contributing the capital and bearing the high risk involved.

5-76. The purpose of INMARSAT is founded in the language of its original convention to make provision for the space segment necessary for improving maritime communications - thereby assisting and improving distress and safety of life, efficiency in management of ships and maritime public correspondence services." The convention also:

- Limits use of the system to "peaceful purposes".
- Makes the system available to ships of all nations.
- Opens membership in the organization to all countries.

5-77. Two decades after it was established, the Telecommunications Act of 1996 allowed INMARSAT to become the first intergovernmental "treaty" organization to privatize and become a limited company. INMARSAT headquarters is in London, and has regional offices in Beijing, Delhi and Dubai.

5-78. Today, INMARSAT partnership includes over 75 countries, 1,000 telecommunications companies providing services to over 140,000 plus Earth Station Terminal users worldwide.

5-79. The convention has since been revised to include aeronautical and land-mobile communications. While the maritime community constitutes the largest share of current users, an increasing number of land-mobile and aeronautical customers are changing the landscape of INMARSAT user demographics.

### Inmarsat - System Structure

5-80. The INMARSAT system became operational on February 1, 1982. The system is designed to support a wide range of communications services to maritime, land-mobile and aeronautical users. The services provided by the INMARSAT system include: direct-dial telephone calls, telex messages, facsimile transmittals, electronic mail, and data transfer, emergency communications and automated position and status reporting.

5-81. Three basic segments comprise the INMARSAT system:

- THE SPACE SEGMENT.
- THE GROUND SEGMENT.
- EARTH STATIONS – Ship Earth Station (SES), Mobile Earth Station (MES), Coast Earth Station (CES) and Land Earth Station (LES).

### Space Segment

5-82. The Space Segment is provided by INMARSAT, and consists of four communication satellites in a geostationary orbit positioned approximately 22,500 miles above the equator on their own meridian of longitude.

5-83. Each satellite has a coverage area (also known as a footprint), which is defined as the area on the earth's surface (sea or land) within which a mobile or fixed antenna can obtain line of sight communications with the satellite.

5-84. Any loss of these space-based communications by U.S. Army Forces remains a major concern for watercraft operators. Whether the interruption of the communications is caused by enemy action against satellites or through the use of intermittent jamming/spoofing, the resulting "black-out" will require Army

watercraft operators to adapt and adjust until the capability is restored. Short term losses of satellite communications (SATCOM) may be mitigated through alternative communication methods such as dead-reckoning navigation.

## Ocean Regions

5-85. Each satellite coverage area corresponds to an Ocean Region. The four Ocean Regions are:

- Atlantic Ocean Region-East (AOR-E).
- Atlantic Ocean Region-West (AOR-W).
- Indian Ocean Region (IOR).
- Pacific Ocean Region (POR).

## Satellite Positions

5-86. The INMARSAT satellite positions are as listed in table 5-4. Based on a 5° elevation angle to the satellite, each ocean region can provide service between the latitudes of 70° north to 70° south. Each satellite provides coverage based on a maximum line of sight distance of 72° from geographical position.

**Table 5-4. INMARSAT satellite positions**

<i><b>Ocean Region</b></i>	<i><b>Atlantic Ocean Region-East (AOR-E)</b></i>	<i><b>Atlantic Ocean Region-West (AOR-W)</b></i>	<i><b>Indian Ocean Region (IOR)</b></i>	<i><b>Pacific Ocean Region (POR)</b></i>
Position	15.5 W	54.0 W	64.5 E	178 E

## Ground Segment

5-87. The Ground Segment comprises a global network of:

- 38 Coast Earth Stations (CES).
- 1 Network Coordination Station (NCS) for each INMARSAT system within each Ocean Region.
- 1 Network Operations Center (NOC).

## Coast Earth Station

5-88. Each coast earth station/land earth station provides a link between the satellites and the national/international telecommunications networks (such as the. Public Switch Telephone Network, PSTN).

5-89. A coast earth station/land earth station (CES/LES) operator is typically a large telecommunications company, which can provide a wide range of communications services to the ship earth stations (SES) or mobile earth stations (MES)

## Priority Indicators

5-90. CES transmit messages according to their priority of communications. There are four levels of priority within the INMARSAT system:

- Level 0 – Routine.
- Level 1 – Safety.
- Level 2 – Urgency.
- Level 3 - Distress.

## Network Coordination Station

5-91. For each INMARSAT system a NCS is located within each Ocean Region, to monitor and control the communication traffic within its Ocean Region

5-92. Each NCS communicates with the CES/LES in its Ocean Region, and with other NCS to insure the proper and prompt transfer of information throughout the system is accomplished.

## Network Operations Center

- 5-93. The items listed below are the operational characteristics of the Network Operations Center:
- Overall responsibility for all INMARSAT communication systems and services.
  - Monitors all CES/LES and NCS to insure that the transfer of information between all stations operates smoothly.
  - Initiates remedial action when needed to prevent system overload.
  - Located in the INMARSAT Headquarters, London, England.

## Ship Earth Stations (SES)

5-94. SESs are communications terminals and their associated peripheral equipment installed aboard ship to enable two-way, multi-mode communications with shore side subscribers. There are separate SES's for each INMARSAT system B, and C.

5-95. The procedure used to initiate a vessel's SES into the INMARSAT system is commissioning through a Coast Earth Station (i.e., COMSAT).

- 5-96. INMARSAT B SES can be purchased as either single channel or multi-channel models.
- Single Channel SES: A single channel SES is capable of using any one of its communication services at a time (i.e. phone, fax or telex), but not more than one service at a time.
  - Multi-Channel SES: Allows the user to operate more than one service at a time on different channels.

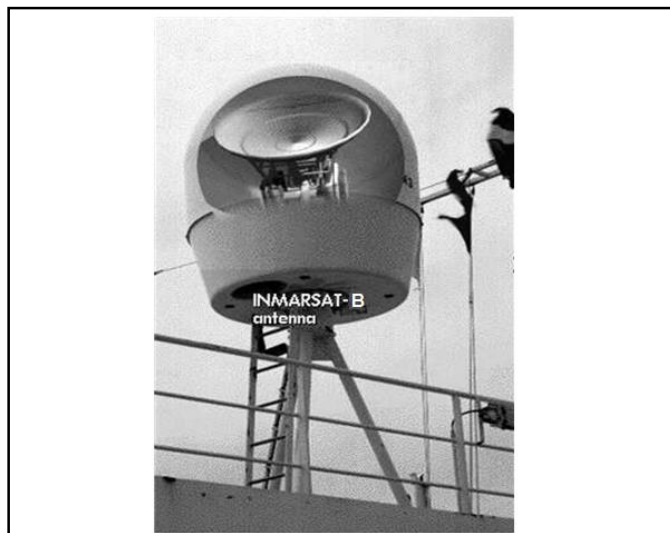
## INMARSAT Above Deck Equipment

5-97. The INMARSAT B SES uses a highly directional, parabolic antenna (see figure 5-3) approximately three (3) feet in diameter. INMARSAT B is a digital system that replaced the analog INMARSAT A, which is no longer recognized for GMDSS. The INMARSAT B antenna is controlled by an electronic control unit that accepts input from the ship's gyrocompass.

5-98. As the ship changes course, the input supplied to the control unit will compensate by keeping the antenna pointed at the satellite as the vessel comes to a new heading.

5-99. A stabilized antenna platform is maintained by a gimbaled assembly which compensates for ship rolling and pitching.

5-100. Finally, step tracking circuitry samples the satellite downlink signal periodically and makes minor adjustments to SES antenna position to optimize signal strength.



**Figure 5-3. INMARSAT B above deck equipment**

**WARNING**

**SOME SYSTEMS WILL AUTOMATICALLY TRANSMIT DATA, SO  
EXTREME CAUTION MUST BE TAKEN WHEN NEAR AN  
INMARSAT B ANTENNA. RADIATION BURNS COULD RESULT.**

**INMARSAT B Below Deck Equipment**

5-101. The below deck equipment consists of:

- A power supply.
- Antenna control unit.
- Access control and signaling equipment.
- Satellite transmitter/receiver unit.
- Telex terminal.
- Telephones.
- Ancillary equipment (e.g., facsimile, PC, modem,).

**INMARSAT C ADE/BDE**

5-102. INMARSAT C above-deck antenna is much smaller. One reason for this is that it is a store and forward system that passes data, but not voice signals. As a result, the usage cost is reduced and more vessels can participate in GMDSS. See figure 5-4 on page 5-18 for examples of INMARSAT C above and below deck equipment.



**Figure 5-4. INMARSAT C above/below deck equipment**

## INMARSAT B

5-103. INMARSAT B is the most recent service introduced by INMARSAT. Digital INMARSAT B service has replaced analog INMARSAT A systems.

5-104. INMARSAT B offers the same multi-mode functional capabilities of INMARSAT A, but because digital technology allows for more efficient use of the system, operational costs can be spread among a larger number of users.

5-105. INMARSAT B offers superior voice quality circuits at lower prices than INMARSAT A. More CES' supporting INMARSAT B service will be phased in during the coming years.

## INMARSAT C

5-106. INMARSAT-C service was introduced in 1991. INMARSAT-C provides two-way store-and-forward messaging capabilities with small, low-cost SES terminals (i.e. laptop computers).

5-107. INMARSAT-C messages encode information into Packet Oriented Protocol (POP) data for transmission over satellites at a rate of 600 bits per second. These messages are reformatted at the Coast Earth Station for delivery to facsimile, telex, data and e-mail systems ashore or to other SES'.

5-108. INMARSAT-C may also be used to interrogate ships at sea for their position, or for automatic data gathering at fixed or variable time intervals (Polling). INMARSAT C terminals are integrated with a GPS.

5-109. Forward Error Correction (FEC) and other techniques are used to insure the integrity of messages received at the Coast Earth Station. Messages are reassembled into their original form and sent to their destination via landline telecommunication networks.

5-110. The time frame for message delivery to a shore side subscriber is not precisely predictable, but most messages are delivered within three to eight minutes.

5-111. The global communications capability of the INMARSAT C system, combined with its Maritime Safety Information (MSI) broadcasting and distress alerting capabilities has resulted in the system being accepted by the IMO as meeting the requirements of the GMDSS. SOLAS now requires that INMARSAT C equipment have an integral satellite navigation receiver, or be externally connected to a satellite navigation receiver. That connection will ensure accurate location information to be sent to a rescue coordination center if a distress alert is ever transmitted.

5-112. INMARSAT C does not have voice capabilities.

### Broadband Global Area Network

5-113. The Broadband Global Area Network (BGAN) is a mobile satellite service that offers high-speed data up to 492 kbps and voice telephony. BGAN enables users to access e-mail, corporate networks and the Internet, transfer files and make telephone calls.

5-114. A complete BGAN system may include the EXPLORER 727 terminal with connected peripherals, an EXPLORER 727 antenna, the BGAN satellite, and the Satellite Access Station (SAS). The satellites are the connection between your terminal and the SAS, which is the gateway to the worldwide networks (Internet, telephone network, cellular network,). The components of the BEGAN systems are shown in figure 5-5.

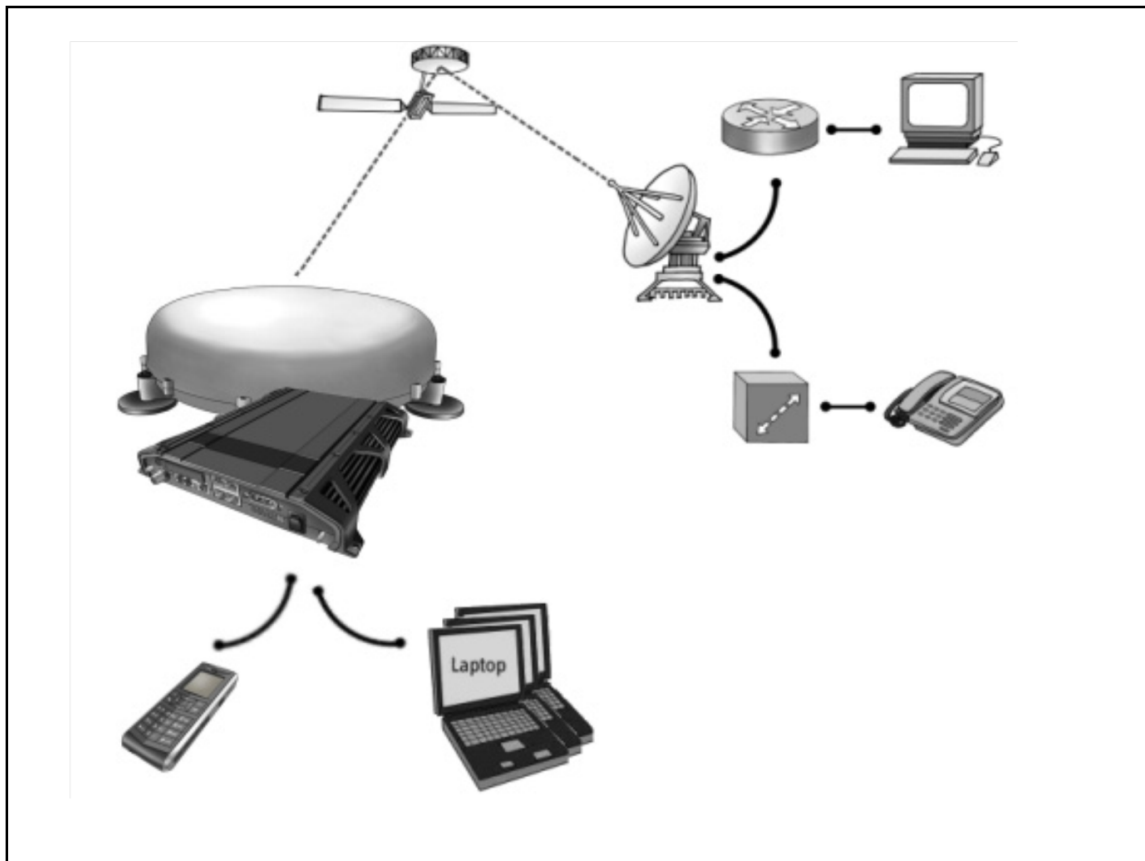


Figure 5-5. Broadband Global Area Network (BGAN)

### Loss Of Communications

5-115. INMARSAT communications require direct wave connectivity between the satellite and the Ship Earth Station (SES). An obstruction, such as a mast, can cause disruption of the signal between the satellite

and the SES antenna when the vessel is steering a certain course. This condition is sometimes referred to as “shadowing.”

5-116. INMARSAT C systems are less likely to be effected by shadowing than the INMARSAT B system, but it could occur. The most effective countermeasure to shadowing is to change course.

5-117. Traveling beyond the effective radius of the satellite or use of a satellite whose signal is on a low elevation or below the horizon may also render INMARSAT communications impossible.

5-118. In marginal circuit conditions, it may be possible to initiate a reliable TELEX transmission but a voice communications may not be possible. Such conditions are indicated by low receiver signal strength on the SES terminal. Communications may become degraded or impossible when satellite elevation, as read on the INMARSAT A SES display becomes very small and is lowering.

5-119. Loss of satellite connectivity to an INMARSAT B unit may require the following data to be manually updated into the terminal:

- Satellites: azimuth & elevation to the satellite.
- Vessels: course, speed, & position of the vessel.

## MF/HF Radio

5-120. All Army vessels that operate in Sea Area A2, excluding Sea Area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC (2187.5 kHz) alerting and radiotelephony services are available, as defined by the International Maritime Organization, must carry a DSC-equipped MF radiotelephone in addition to equipment required for Sea Area A1. Table 5-5 lists the U.S. Coast Guard DSC equipped shore stations.

**Table 5-5. U.S. Coast Guard Digital Selective Calling (DSC)-equipped shore stations**

<b>Station</b>	<b>Type</b>	<b>Remote Site</b>	<b>Maritime Mobile Service Identity (MMSI)</b>
Communication Station (COMMSTA) Chesapeake VA	Medium Frequency (MF)/High Frequency (HF)	Communications Area Master Station Atlantic (CAMSLANT)	003669995
COMMSTA Boston MA	MF/HF	Remote to CAMSLANT	003669991
COMMSTA Miami FL	MF/HF	Remote to CAMSLANT	003669997
COMMSTA Belle Chase LA	MF/HF	Remote to CAMSLANT	003669998
Communications Area Master Station Pacific (CAMSPAC) Pt Reyes CA	MF/HF	N/A	003669990
COMMSTA Honolulu HI	MF/HF	Remote to CAMSPAC	003669993
COMMSTA Kodiak AK	MF/HF	Remote to CAMSPAC	003669899

## VHF RADIO

5-121. Every Army vessel shall have on the bridge two operational VHF radios. A single VHF FM radio capable of scanning or sequential monitoring (often referred to as "dual watch" capability) will not meet the requirements for two radios. Channel 16 is the international distress and hailing frequency.

5-122. Use of the designated frequency (taken from Title 33 CFR, Part 26):

- No person may use the frequency designated by the Federal Communications Commission under section 8 of the Act, Title 33 CFR. 1207(a), to transmit any information other than information necessary for the safe navigation of vessels or necessary tests.
- Each person who is required to maintain a listening watch under Section 5 of the Act shall, when necessary, transmit and confirm, on the designated frequency, the intentions of his vessel and any other information necessary for the safe navigation of vessels.



- Nothing in these regulations may be construed as prohibiting the use of the designated frequency to communicate with shore stations to obtain or furnish information necessary for the safe navigation of vessels.
- On the navigable waters of the United States, channel 13 (156.65 megahertz (MHz)) is the designated frequency required to be monitored in accordance with §26.05(a) except that in the area prescribed in §26.03(e), channel 67 (156.375 MHz) is an additional frequency.
- On those navigable waters of the United States within a Vessel Traffic Service (VTS) area, the designated VTS frequency is the designated frequency required to be monitored in accordance with §26.05.
- Whenever radiotelephone capability is required by this Act, a vessel's radiotelephone equipment shall be maintained in effective operating condition. If the radiotelephone equipment carried aboard a vessel ceases to operate, the master shall exercise due diligence to restore it or cause it to be restored to effective operating condition at the earliest practicable time. The failure of a vessel's radiotelephone equipment shall not, in itself, constitute a violation of this Act, nor shall it obligate the master of any vessel to moor or anchor his vessel; however, the loss of radiotelephone capability shall be given consideration in the navigation of the vessel.

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**Note.** As stated in Title 47 CFR 80.148(B), a VHF watch on channel 16 (156.800MHz) is not required on vessels subject to the vessel bridge-to-bridge radiotelephone act and participating in a vessel traffic service (VTS) system when the watch is maintained on both the vessel bridge-to-bridge frequency and a designated VTS frequency.

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## DIGITAL SELECTIVE CALLING

5-123. The IMO also introduced digital selective calling (DSC) on VHF, MF and HF maritime radios as part of the GMDSS system. DSC is primarily intended to initiate ship/ship, ship/shore, and shore/ship radiotelephone and MF/HF radio telex calls. DSC calls can also be made to individual ships or groups of ships. DSC distress alerts, which consist of a preformatted distress message, are used initiate emergency communications with ships and rescue coordination centers. DSC was intended to eliminate the need for persons on a ship's bridge or on shore to continuously guard radio receivers on voice radio channels, including VHF channel 16 (156.8 MHz) and 2182 kHz now used for distress, safety and calling. A listening watch aboard GMDSS-equipped ships on 2182 kHz ended on 1 February 1999.

5-124. IMO and ITU both require that the DSC-equipped VHF and MF/HF radios be externally connected to a satellite navigation receiver. That connection will ensure accurate location information is sent to a rescue coordination center if a distress alert is ever transmitted. FCC regulations actually require that ship's position be manually entered into the radio every four hours on ships required to carry GMDSS equipment, while that ship is underway. The Coast Guard believes VHF, MF and HF radiotelephone equipment carried on ships should include a DSC capability as a matter of safety. To achieve this, the FCC requires that all new VHF and MF/HF maritime radiotelephones type accepted after June 1999 to have at least a basic DSC capability.

## SHIP RADIO AUTHORIZATION

5-125. Transmitter equipment will only be operated on those frequencies/channels authorized by the appropriate frequency management authority.

5-126. Operations will conform to Federal Communications Commission rules and regulations, part eight, rules governing stations on shipboard in the maritime service.

5-127. Ships operating on tactical nets using frequencies designated by competent authority will use tactical call signs designated by the same authority.

5-128. This ship radio authorization is authorized only for the periods indicated. If not renewed by the expiration date, the call sign will be assigned to another vessel.

5-129. When C-E equipment is permanently removed from the vessel, the vessel is sold, scrapped, or otherwise disposed of, or the vessel is transferred to another agency, the Department of the Army, NETCOM ESTA IPD office will be notified immediately, at (703) 325-8225.

## **RADIO FREQUENCY AUTHORIZATION**

5-130. This document is posted so that any radio equipment and operators on the vessel can communicate on commercial, open channel frequencies with approval by the Department of the Army. Only the Army Spectrum Management Office, Department of the Army, provides the legally required documentation. This document is issued only to the vessel by hull number and does not belong to any other entity. Radio Frequency Authorizations are valid for only three (3) years and must be renewed by requesting vessel/unit to the address listed below.

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### **Ship Radio Authorization**

Army Spectrum Management Office

2461 Eisenhower Ave, Suite 1204

Alexandria, VA 22331-2200

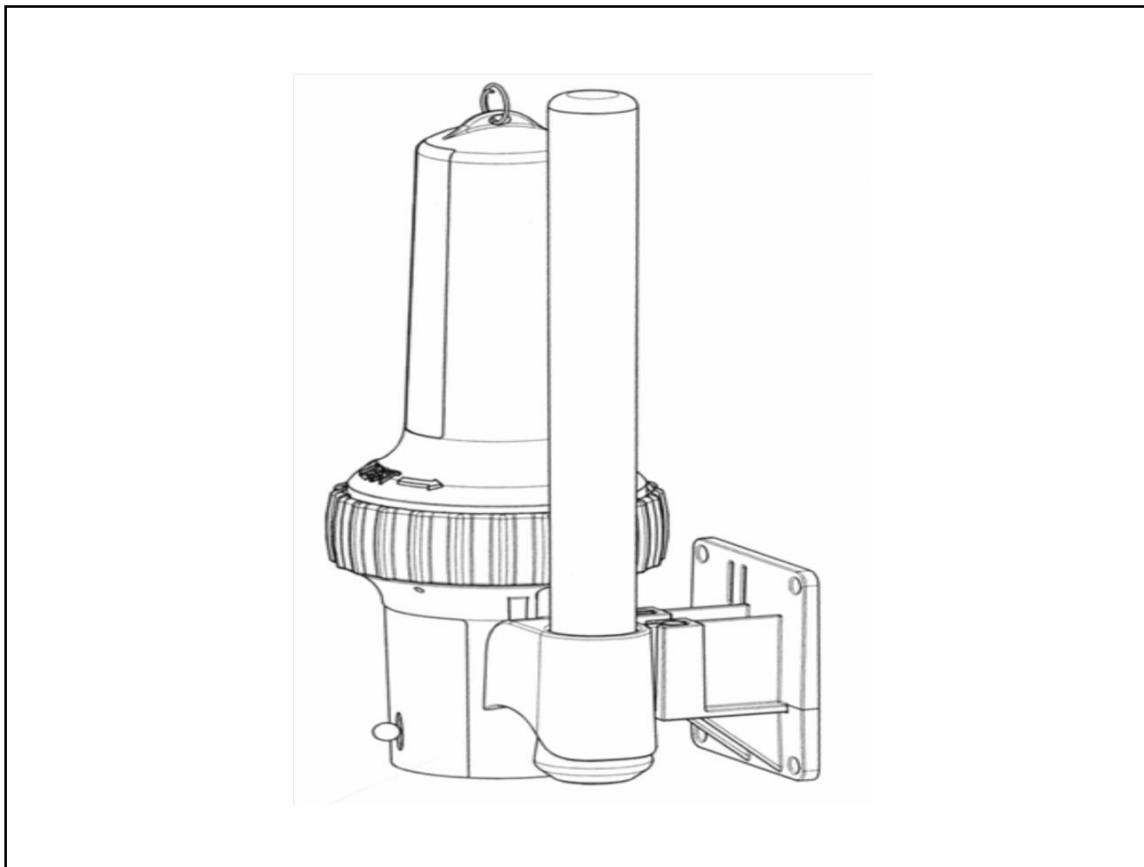
PH (703) 325-8225 or FAX 325-4138

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## **SEARCH AND RESCUE TRANSPONDER**

5-131. Actuating a Search and Rescue Transponder (SART) enables a survival craft to show up on a search vessel's radar display as an easily recognized series of dots. RADAR (radio detection and ranging) is a device carried by most ships which is used to determine the presence and location of an object by measuring the time for the echo of a radio wave to return from it, and the direction from which it returns. A typical ship's radar will transmit a stream of high power pulses on a fixed frequency anywhere between 9.2GHz and 9.5GHz. It will collect the echoes received on the same frequency using a display known as a plan position indicator, which shows the ship itself at the center of the screen, with the echoes dotted around it. Echoes further from the center of the screen are thus further from the ship and the relative or true bearing of each echo can be easily seen. See figure 5-6 on page 5-23 for a graphic depiction of the SART

5-132. The SART operates by receiving a pulse from the search radar and sending back a series of pulses in response, which the radar will then display as if they were normal echoes. The first return pulse, if it sent back immediately, will appear in the same place on the plan position indicator as a normal echo would have done. Subsequent pulses, being slightly delayed, appear to the radar like echoes from objects further away. A series of dots is therefore shown, leading away from the position of the SART. This distinctive pattern is much easier to spot than a single echo such as from a radar reflector. Moreover, the fact that the SART is actually a transmitter means that the return pulses can be as strong as echoes received from much larger objects.



**Figure 5-6. Search and rescue transponder (SART)**

### **AUTOMATIC IDENTIFICATION SYSTEM**

5-133. The International Maritime Organization's (IMO) carriage requirement for automatic identification system (AIS) will substantially enhance safety at sea giving ship's officers improved situation awareness for collision avoidance. AIS will also provide better land-based services for mariners from VTS as well as improved security, environment and safety in ports and along coasts. See figure 5-7 on page 5-24.



Figure 5-7. Automatic identification system

## **Appendix A**

# **Battery Maintenance**

There are different types of batteries such as lead-acid batteries, gel cells, and lead-calcium batteries. Most batteries contain sulfuric acid and lead. Because batteries contain chemicals, chemical reaction by-products, and an electrical current, they can pose a hazard to soldiers if not handled properly. Soldiers that operate, maintain, and recharge batteries should always use caution.

### **BATTERY HANDLING**

A-1. Before working with batteries, Soldiers should have training in proper handling procedures. Personal protective equipment should be worn at all times. This includes:

- Chemical splash goggles.
- Face shield.
- Acid-resistant equipment such as gauntlet style gloves, an apron, and boots.
- In order to keep acid out of boots, do not tuck pant legs into boots.

A-2. The sulfuric acid (electrolyte) in batteries is highly corrosive. Acid exposure can lead to skin irritation, eye damage, respiratory irritation, and tooth enamel erosion. Remember the following safety precautions:

- Never lean over a battery while boosting, testing or charging it.
- In marine environments, do not allow the battery solution to mix with salt water; it can produce hazardous chlorine gas.
- If acid splashes on the skin or eyes, immediately flood the area with cool running water for at least 15 minutes and seek medical attention immediately.
- Always practice good hygiene and wash your hands after handling a battery and before eating to prevent lead exposure. Signs of lead exposure include loss of appetite, diarrhea, and constipation with cramping, difficulty sleeping and fatigue.

A-3. The chemical reaction by-products from a battery include oxygen and hydrogen gas. These can be explosive at high levels. Overcharging batteries can also create flammable gases. For this reason, it is very important to store and maintain batteries in a well-ventilated work area away from all ignition sources and incompatible materials. Cigarettes, flames or sparks could cause a battery to explode.

A-4. Before working on a battery, disconnect the battery cables. To avoid sparking, always disconnect the negative battery cable first and reconnect it last. Be careful with flammable fluids when working on a battery-powered engine. The electrical voltage created by batteries can ignite flammable materials and cause severe burns. Soldiers have been injured and killed when loose or sparking battery connections ignited gasoline and solvent fumes during vehicle maintenance.

A-5. Battery maintenance tools should be covered with several layers of electrical tape to avoid sparking. Place protective rubber boots on battery cable connections to prevent sparking on impact if a tool does accidentally hit a terminal. Clean the battery terminals with a plastic brush because wire brushes could create static and sparks. Always remove your personal jewelry before working on a battery. A short-circuit current can weld a ring or bracelet to metal and cause severe burns.

A-6. Batteries can be very dense and heavy, so use proper lifting techniques to avoid back injuries. Battery casings can be brittle and break easily; they should be handled carefully to avoid an acid spill. Make sure that a battery is properly secured and upright in the vehicle or equipment. If a battery shows signs of damage to the terminals, case or cover, replace it with a new one. Finally, remember to dispose of old batteries properly. All parts are ordered by their NSN.

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## Appendix B

### Eye/Face Wash Station

Title 29 CFR (subparagraph 1910.151) states the following: “Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.” Chemical burns of the eyes need immediate first aid attention. Any delay in treatment will generally aggravate and intensify the injury. Initial treatment is actively flushing out the eyes with plenty of water. Irrigation should continue for a period of 15 to 30 minutes. This amount of time is usually adequate for the more serious chemicals. Though the initial flushing of the eyes or face is good, seek medical attention as soon as possible. This appendix provides detailed information on the two types of eye/face wash stations, plumbed and portable, that are found on Army watercraft.

#### PLUMBED/PORTABLE WASH STATIONS

B-1. The following units can be located at the eye/face wash station:

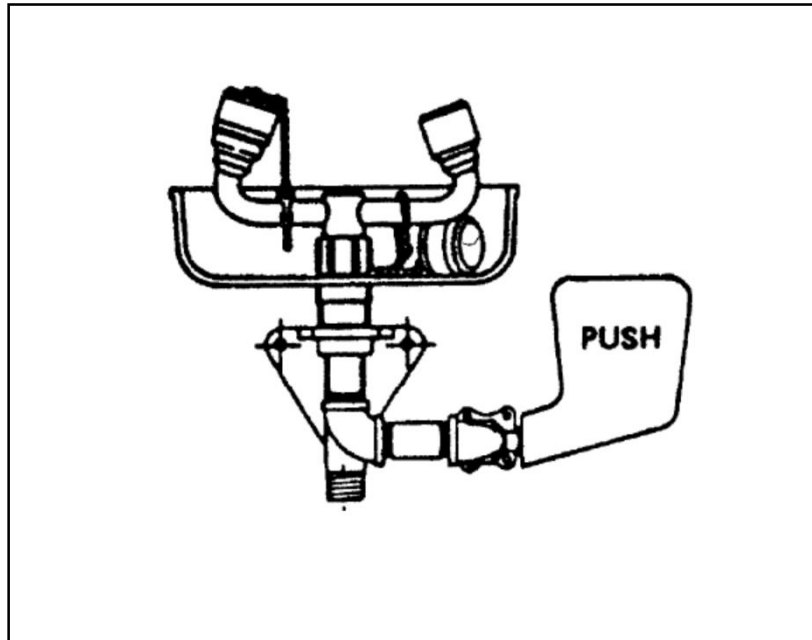
- **Plumbed Eye/Face Wash Units.** A plumbed eye/face wash unit is a permanently installed station that has a continuous supply of water. The supply line for plumbed units (see figure B-1 on page B-2) will provide an uninterrupted supply of water at approximately 30 psi. When installed, the actuation valve will be operated to determine that both eyes will be washed simultaneously at a velocity low enough not to cause injury to the user. The valve shall be designed so that the water flow remains on without requiring the use of the operator’s hands. The valve shall be designed to remain activated until intentionally shut off. The valve should be simple to operate and shall go from “off” to “on” in one second or less. The valve shall be resistant to corrosion from potable water. The valve actuator will be large enough to be easily located and operated by the user. Plumbed eye/face wash units will be activated weekly to flush the line and to verify proper operation.
- **Portable Eye/Face Wash Units.** Portable eye/face wash fountains (figure B-2 on page B-2) generally are units which work on a gravity-fed system (normally holding 10 to 16 gallons of water). Self-contained units will be constructed of materials that will not corrode in the presence of the flushing fluid. There should be no sharp projections anywhere in the operating area of the unit. Nozzles shall be protected from airborne contaminants. Whatever means is used to afford such protection, its removal shall not require a separate motion by the operator when activating the unit. The unit will also be large enough to provide room to allow the eyelids to be held open with the hands while the eyes are in the stream of water. There is an anti-fungus additive for portable units to extend requirements for refilling according to the manufacturer recommendations. Water contained in system should be changed at regular interval so that any fungus or other possible contaminants are prevented from forming. Change out date should be posted on container so that the dated label is NOT easily removed.

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**Note.** Every effort shall be made to install permanent eye/face fountains in all areas requiring an emergency eye/face wash capability.

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B-2. No portable eye/face wash units shall be permitted in areas where a chemical splash hazard exists and where there is a continuous source of clean water available. Portable eye/face wash fountains will be allowed in remote areas when no continuous flow of fresh water is available, when the installation of a fresh water system is not economically feasible, and when the hazard of chemical splash is minimal.



**Figure B-1. Plumbed eye/face wash unit (typical)**



**Figure B-2. Portable eye / face wash unit**

## LOCATION

B-3. Eye/face wash units should be in accessible locations that require no more than 10 seconds to reach and should be within a travel distance no greater than 100 feet from the hazard. Specific installation instructions include that the unit be positioned about 45 inches from the floor. Each eye/face wash station shall be identified with a highly visible sign. The area around or behind, or both, the eye/face wash station will be painted a bright color and will be well lighted. If there is a specific working area that is used for only hazardous chemicals, then the wash station would be immediately adjacent to or within 10 feet.

## TRAINING

B-4. All personnel who might be exposed to chemical splash will be instructed in the proper location and use of emergency eye/face wash stations.



## **Appendix C**

# **Power Tool Safety**

Power tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards.

C-1. The following lists some general rules and guidelines for the use and handling of power tools:

- Never carry a tool by the cord.
- Never yank the cord to disconnect it from the receptacle.
- Keep cords away from heat, oil, and sharp edges (including the cutting surface of a power saw or drill).
- Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits.
- Avoid accidental starting. Do not hold fingers on the on/off switch button while carrying a plugged-in tool.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

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## Appendix D

### Color Coding

Piping systems on Army watercraft are required to be color-coded. Valve handle and flow direction arrows are identified by colors. Additionally, for long piping runs, the piping should be marked either with the product name or color-coded banding. All fire main piping must be labeled “fire main” in addition to the previously mentioned markings.

D-1. Standardization of piping systems makes for easy identification by all crewmembers, who should be familiarized with the color codes and applications. Table D-1 identifies the color with the corresponding application.

**Table D-1. Watercraft color coding**

<b><i>Color</i></b>	<b><i>Application</i></b>
Dark Green	Bilge system, sea water system
Purple	Refrigerant system
Dark Gray	High pressure air system
Tan	Low pressure air system
Yellow	Diesel fuel systems containers Naphtha containers (paint entire containers)
Orange	Lubricating oil, Hydraulic oil
Red	Fire extinguishing system
Black	Steam and hot water heating system
Dark Blue	Non-potable fresh water system
Light Blue	Potable water system
Gold	Sewage
Yellow	Oil water separator suction

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## **Appendix E**

# **Personal Protective Equipment**

Personal protective equipment is equipment worn to minimize exposure to a variety of hazards. This appendix discusses the importance of using eye and face protection and gloves to protect personnel from injury.

## **EYE AND FACE PROTECTION**

E-1. Soldiers must use appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, acids or caustic liquids, or other liquid chemicals, chemical gases or vapors, or potentially hazardous light radiation sources.

E-2. Face shields are used in operations when the entire face needs protection and to protect the eyes and face against flying particles, metal sparks, and chemical or biological splash hazards. Face shields must be used in combination with goggles when there is a potentially significant chemical splash hazard or when there is a potentially severe exposure to flying fragments or objects, hot sparks from furnace operations, potential splash from molten metal, or extreme temperatures.

E-3. Standard safety glasses are designed to protect against flying particles. Soldiers must use safety eyewear with side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on shields) are acceptable if they meet the American National Standards Institute (ANSI) requirements.

E-4. Goggles offer the best all-around impact protection of all eyewear types because they form a positive seal around the eye area. Welders' goggles provide protection from sparking, scaling, or splashing metals and harmful light rays. Welding shields must be provided to protect soldiers' eyes and face from infrared or radiant light burns, flying sparks, metal spatter and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electrical arc welding, and oxyacetylene work. Lenses are impact resistant and are available in graduated shades of filtration.

E-5. Soldiers must use equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious light radiation. Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

E-6. Soldiers who wear prescription lenses, while engaged in operations that involves eye hazards, must either:

- Wear eye protection that incorporates the prescription in its design, or,
- Wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

## **MAINTENANCE OF PROTECTIVE EYEWEAR**

E-7. Safety glasses and other eye and face protection should be stored carefully so they won't be scratched or damaged. In general, do not store this equipment where it would be exposed to high heat or sunlight.

E-8. Inspect eye and face protection prior to use. If the equipment is damaged or broken, do not use it because it may not be able to fully resist impact.

E-9. Pitted lenses, like dirty lenses, make it more difficult for an employee to see and should be replaced. Lenses that are pitted or deeply scratched are more prone to break under impact and should be replaced.

E-10. Clean eye and face protection according to the manufacturer's instructions. If the manufacturer's instructions are not available, clean with a mild soap and water solution by soaking in the soap solution for ten minutes. Rinse thoroughly and allow to air dry.

## **GLOVES**

E-11. Gloves are worn when the possibility of injury to either fingers or hands exist. Examples of possible injury occurring are during line handling, painting, moving or lifting heavy objects, securing or unsecuring cargo, rigging tows using wire cable, chain, or synthetic lines.

## **Appendix F**

# **Equipment Guards**

Equipment guards come in many types and sizes, each one depending on what they are used for. Machinery guards are used to prevent injuries from any of the moving pieces on the equipment. Also included in this category are explosion-proof light globes. These globes usually include wire cages and help contain any fumes associated with the lighting.

### **EQUIPMENT GUARD TYPES**

F-1. The four main equipment guards used aboard Army watercraft include:

- Fixed.
- Interlocked.
- Adjustable.
- Self-Adjusting.

#### **Fixed guards**

F-2. Fixed guards are a permanent part of the machinery and are not dependent on any other part to perform their function. These guards are usually made of sheet metal, screen, bars, or other material which will withstand an anticipated impact. Fixed guards are considered the preferred type of guard because they are simple yet durable.

#### **Interlocked guards**

F-3. Interlocked guards are usually connected to a mechanism that will cut off the power automatically. These types of guards are typically used on electrical, mechanical, or hydraulic systems. Interlock guards are normally on manual reset systems that can be regulated.

#### **Adjustable Guards**

F-4. Adjustable Guards are very flexible to accommodate various types of stock. They are self-adjusting, but may also be adjusted manually.

#### **Self-Adjusting**

F-5. The opening of the self-adjusting is determined by the movement of the stock through the guard. This type of guard does not always provide maximum protection

### **EXPLOSION PROOF GUARDS**

F-6. Explosion proof guards are made of heavy clear glass or plastic lens and screw over a light bulb into the light fixture. Depending on the type, many explosion proof globes also have wire cages over the clear lens. These cages are also screwed over the lens. The globe is designed to contain any spark which may be caused by light bulb should it be broken. The cages are designed to prevent impact to both the globe and bulb.

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## **Appendix G**

# **Gangways**

Gangways are walkways that provide access from land to a structure on the water and vice versa. Appendix G provides characteristics and safety considerations for gangways that are used on Army watercraft.

### **CHARACTERISTICS**

G-1. Whenever practicable, a gangway of not less than 20 inches (.51 m) in width, of adequate strength, maintained in safe repair and safely secured shall be used. Each side of the gangway, and the turntable, if used, shall have a handrail with a minimum height of 33 inches (.84 m) measured perpendicularly from rail to walking surfaces at the stanchion, with a mid-rail. Rails shall be of wood, pipe, chain, wire, rope or materials of equivalent strength and shall be kept taut always. Portable stanchions supporting railings shall be supported or secured to prevent accidental dislodgement.

### **SAFETY CONSIDERATIONS**

G-2. Gangway access shall be illuminated for its full length as per Title 29 CFR 1918.21. The gangway shall be kept properly trimmed. MSC.1/Circular/1331, dated 11 June 2009 specifies no more than a 30 degree angle from the horizontal. Accommodation ladders can have no more than a 55 degree angle. Vessels that moor in higher latitudes that have greater tide ranges will most likely need a step down platform on the shore side to reduce the gangway angle. When a fixed flat tread accommodation ladder is used, and the angle is low enough to require soldiers to walk on the edge of the treads, cleated duckboards shall be laid over and secured to the ladder. Gangways that overhang the water must have a net suitable for protecting persons from falling. If there is any possibility of someone falling between the vessel and the pier, there must be net to prevent injuries. If the foot of a gangway is more than one foot (.30 m) away from the edge of the apron, the space between them shall be bridged by a firm walkway equipped with a hand rail with a minimum height of approximately 33 inches (.84 m) with mid-rails on both sides. Gangways shall be kept clear of all obstructions. Unobstructed passage must be provided, and any hazards that cannot be removed will be marked. Obstructions shall not be laid on or across the gangway. Handrails and walking surfaces of gangways shall be maintained in a safe condition to prevent soldiers from slipping or falling. MSC.1/Circular/1331 states that gangways cannot be secured to hand rails unless the railing is designed for that purpose. Gaps between the gangway and railings must be properly secured. Gangways should be repaired as needed. Bent stanchions and walking surfaces should be replaced or repaired. Moving parts such as wheels, should turn freely and be greased as needed. The underside of gangways should be examined at regular intervals. MSC.1/Circular/1331 recommends a ring buoy with water light be stationed near the gangway.

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## Appendix H

# Lockout / Tagout of Energy Sources

Lockout/tagout of energy sources are necessary due to the complexity of modern Army watercraft and the cost and potential effects of delays associated with equipment down time. These are also required due to the hazards to personnel which could result in their injury or in the worst case, death. This lockout/tagout program is mandatory for all Army watercraft. The program is designed to notify personnel that locked/tagged equipment or systems are NOT to be operated under any circumstances.

## LOCKOUT/TAGOUT PROCEDURES AND RESPONSIBILITIES

H-1. The lockout/tagout system consists of a series of locks and tags that are attached to individual components to indicate that they are restricted from operation (red danger tag). Each tag contains the necessary information to prevent a possible injury to personnel or damage to installed equipment. Tags associated with the tagout procedure should never be used for valve identification, for marking leaks, or any other purpose not specified in this tagout procedure. Locks must be placed on the initial energy source (whether electrical, air, or fluid) nearest the item to be tagged. Use of locking devices is mandatory so that equipment needing or under repair/replacement cannot be energized.

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**Note.** All Class Bravo (B) and Charlie (C) vessels, without 20 level certificated personnel, will comply with vessel support office (VSO) SOP.

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H-2. The use of tags or other labels is not a substitute for other safety measures such as chaining or locking valves, removing fuses, or racking out circuit breakers. However, tags will be attached to the fuse panel, racked out circuit breaker cabinet or locked valve, to indicate the need for such action. If any component has more than one type of tag or sticker attached; the DANGER (RED) tag, when present, will take precedence over all other tags or stickers. Standard lockout/tagout procedures are to be used for all maintenance, including work to be done by support maintenance units and local contractors. Each maintenance action will require its own set of tags even if two or more maintenance actions require the same equipment to be tagged. Never rely on the tags from other maintenance actions to provide protection for the work you are assigned to do. Lockout/tagout procedures will be enforced at all times. Violation of any tag compromises the entire tagout system and could in itself have serious consequences. Therefore, strict adherence to the tagout procedure without exception is required by all personnel. Lockout/tagout training should be conducted for all crewmembers to insure they are familiar with all procedures and meaning of various tags.

H-3. Both the red Danger tags and the yellow Caution tags are available through the supply system. However, if these are not available, any tag (EXCEPT reusable (laminated) tags) are authorized as long as it contains the following minimum information:

- Time and date the work was started.
- Person performing the work.
- Affected circuits/system/component.
- Approval signature of the Chief Engineer or Electrical Officer.
- The required position of the affected switch, breaker, or fuse (such as closed, open, or removed).

## PROGRAM RESPONSIBILITIES

H-4. The following are the responsibilities of the Vessel Master, Chief Engineer, company commander, and company and/or battalion marine maintenance officer.

- Vessel Master: The vessel master is responsible for ensuring these procedures are properly utilized aboard his/her assigned watercraft.

- Chief Engineer: Aboard Army watercraft, the chief engineer is the authorizing officer. Insures all crewmembers are familiar with lockout/tagout procedures and tag meanings.
- Company Commander: The company commander is responsible for ensuring his/her unit is in compliance with these procedures. The commander ensures that these procedures are addressed within the company maintenance SOP to include the proper indoctrination of new unit personnel.
- Company and/or Battalion Marine Maintenance Officer: The company/battalion marine maintenance officer will routinely audit individual vessels to ensure compliance with this program.

### APPLICATION

H-5. These requirements apply to all maintenance actions performed aboard Army watercraft where the unexpected energizing, startup, or release of stored energy of equipment would be likely to endanger personnel or the equipment itself.

H-6. The following describes terms related to lockout/tagout procedures.

- Authorizing officer: The authorizing officer for lockout/tagout on Army watercraft will be the chief engineer.
- Energy isolating device: A mechanical device that physically prevents the release or transmission of energy. These devices include but are not limited to the following: Manually operated breakers, disconnects, or switches, valves, blank flanges.

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**Note.** Push buttons, selector switches, and other types of circuit devices ARE NOT energy isolating devices.

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- Energy source: Any device, component, or system which contains potential energy capable of injuring personnel or damaging installed equipment. Energy sources may be electrical, pneumatic, hydraulic, thermal, chemical, or in a mechanical form such as a rotating element.
- Lockout device: A device that uses a positive means such as a lock to hold an energy isolating device in a safe position preventing the energizing of equipment or the release of another form of energy. Lockout devices include any device which mechanically prevents the energy isolating device from being repositioned. See figure H-1 on page H-3 for an example of a Danger Lockout device. If a lockout device is not available, a simple wire rope with clips may also be used.
- Maintenance action: Any preventative or corrective maintenance performed by the vessel's crew and support unit maintenance personnel and private contractor personnel. Each maintenance action will require its own set of tags. This does not include maintenance performed during a cyclic maintenance period. Lockout/tagout will be governed by the shipyard performing the cyclic maintenance.
- Tagout: Tags affixed to energy isolating devices for warning purposes. They DO NOT provide the physical restraint that lockout devices provide. These tags are as follows:
  - Danger tag (see figure H-2 and page H-3): This tag is red. It prohibits the operation of equipment that could jeopardize the safety of personnel or endanger equipment and associated systems. Under no circumstances will equipment be operated when danger tags are attached. Laminated danger tags intended for repeated use will not be used aboard Army watercraft.
  - Caution tag (see figure H-3 on page H-4): This tag is yellow. It is used as a precaution to advise personnel of temporary special instructions or to indicate that unusual caution must be exercised to operate equipment. These instructions must state the specific reason why the tag is installed. The phrase "Do not operate without the chief engineer's permission" is not acceptable since no equipment should be operated without direct permission.
- Tagout log: The tagout log consists of the Tagout Index, active Tagout Record Sheets, and the inactive Tagout Record Sheets. The Tagout Index and Tagout Record provides a means of tracking actions, ensures that serial numbers are sequentially issued, and assists in conducting audits and reviews of the tagout program for the vessel. It also provides a ready means of referral for the crew. The sheet may be locally reproduced.

Figure H-1 Danger lockout device



Figure H-2 Danger tag



Figure H-3. Caution tag

## PROCEDURES

H-7. The following describes lockout/tagout procedures to be followed by all Army watercraft personnel.

### Preparation of Tags and Logs

H-8. Danger and Caution tags.

- Each tagout action is assigned a serial number in sequence from the Tagout Log Index. This serial number will also be used to identify each tag associated with the tagout action. When a tagout action requires more than one tag, the same base number will be used with a sequence number to identify individual tags (for example, 001-1, 001-2, and so on).
- Tagout entries will provide sufficient information to give personnel reviewing the log a clear understanding of the purpose and necessity for each tagout action.
- Enough tags and lockout devices will be used to completely isolate the system or component being worked on and to prevent operation of a system or component from all stations that could exercise control. System diagrams and circuit schematics should be used to determine the adequacy of all tagout actions.
- The person requesting the tags will prepare the Tagout Record Sheet and associated tags.
- The Authorizing Officer (normally the Chief Engineer) will review the tagout log entries and tags for completeness and accuracy. When satisfied, the Authorizing Officer will sign the Tagout Record Sheet and tags authorizing the installation of the tags.
- The person attaching the tags and lockout devices will ensure that the items being tagged are in the prescribed position or condition (for example, shut, locked shut, fuses removed, and so on) exactly as stated on the tag, then sign and attach the tags and locking devices if required. The tags will be securely attached so they are apparent to anyone who may try and operate the component.
- After the tag is attached, a second person will independently verify the tagged equipment or component is in the position or condition indicated on the tag and that the tag and lockout device, if required, is properly attached. That person will sign the tags and the Tagout Record Sheet. Only qualified personnel will perform the second check of tag installation.

- Locking devices and tags are only valid for 30-day increments. One of three occurrence must happen at the end of this time frame:
  - Equipment is repaired and returned to normal usage. Devices and tags are removed and tagout record sheet properly annotated.
  - The identified system, locking devices, and tags are inspected by the same individuals who initiated the process to ensure validity. Tags and tagout record sheet are annotated with new date.
  - When in initiating individuals are not available, the original devices and tags are removed and the tagout record sheet reflects the entry being “cleared”. This procedure causes the lockout/tagout process to begin from the beginning with a new equipment serviceability inspection and the issuing of new lockout/tagout with new date and assignment number.

### Tagout Record Sheet

H-9. The purpose of the tagout record sheet is to exchange information concerning tagout actions. Tagout record sheets are created to provide a clear understanding of the purpose and necessity for each tagout action. Sheet entries will be complete, accurate, and legible. The Tagout Record Sheet can be produced by the unit with all the required information listed in Table H-1 documented (see Table H-1 below and on continuing on page H-6).

**Table H-1 Information for Tagout Record Sheet**

<b><i>Procedures for tagout record sheet</i></b>
Log serial number. Each Tagout is assigned a log serial number in sequence. The Tagout Index will be used for assigning log serial numbers. Enter the system or component being tagged out.
The reason for the Tagout, the hazards involved, amplifying instructions, and work necessary to clear the tags will be sufficiently detailed to give watch standers reviewing the Tagout Log a clear understanding of the purpose of and necessity for each Tagout action.
Enough tags should be used to completely isolate the system, piping, or circuit being worked on or to prevent operation of a system. Each tag will contain the Log serial number followed by a dash and number (Example: 001-1). The -1 indicated the first tag for serial number 001. Additional tags would be numbered -2, -3, and so on.
The location (for example #1 Small Scale Distributed Generation (SSDG) circuit breaker) and the position/condition (for example: open, shut, locked shut, racked out, fuses removed, and so on) of the tagged item should be indicated by the most easily identifiable means. The position/condition column need not be filled in for caution tags.
The Authorizing Officer will review the Tagout Record Sheet and tags for completeness and accuracy. When satisfied, he/she will sign and enter the date/time the Tagout Record Sheet and tags authorizing the tags to be installed.
The individual installing the tags and locking devices will reposition the item to conform to the required position / condition as stated on the tag. He/she will then sign the tag and then hang it. This same individual will then initial the Tagout Record Sheet indicating the tag and locking devices were installed.
After the person initiating the Tagout has completed installing the tags, a second individual will independently check each tag to ensure the tag and any locking devices are properly installed and the item is in the proper condition/position. This individual will sign the tag and then initial the Tagout Record Sheet to indicate the tag was correctly installed.

**Table H-1 Information for Tagout Record Sheet Continued**

<b><i>Procedures for tagout record sheet</i></b>
After the work is completed, the Authorizing Officer (Chief Engineer) will inspect and when satisfied, authorize removal of the tags by signing the Tagout Record Sheet.(exception is class B and C vessels without 20 level certified engineer on board)
The individual assigned to clear the tags and locking devices will enter the date/time the tag was cleared and initial the Tagout Record Sheet indicating the tag was removed. All removed tags will be returned to the Authorizing Officer for destruction. The Tagout Record Sheet will be filed in the inactive section of the Tagout Log for six months.

**Tag Removal**

H-10. Danger and Caution tags will be removed immediately when the situation requiring the tagout has been corrected. Danger tags will be properly cleared and removed before a system or portion of a system is operationally tested and restored to service.

- No tags and lockout devices will be cleared without the approval of the Authorizing Officer. The Authorizing Officer's approval will be annotated on the Tagout Record Sheet.
- The person who initiated the tagout should, if possible, be the person who clears the tags. However, do not delay the removal of tags when work is completed and the individual is not available.
- As the tags and lockout devices are removed, they will be returned immediately to the Authorizing Officer. Using the returned tags and Tagout Record Sheet, the Authorizing Officer will verify that all the tags have been cleared by all parties. The date and time cleared will be annotated on the Tagout Record Sheet and the date entered on the Tagout Index Sheet.
- Removed tags will be destroyed after they have been delivered to the Authorizing Officer. The Authorizing Officer will file it in the inactive section of the Tagout Log. Inactive Tagout Record Sheets will be maintained for six months, and then destroyed.

**Lost or Missing Tags**

H-11. Tags which are missing or have come off the item to which they are to be attached will immediately be reported to the authorizing officer.

- The authorizing officer will direct a new tag to be added to the Tagout Record Sheet using the above procedure for initiating a tagout.
- After the new tag is installed and verified by a second party, the authorizing officer will then clear the old tag from the Tagout Record Sheet using the above procedures for clearing/removing tags.



## **Appendix I**

### **Signage**

Signage is used for identification or as a means of giving directions or warnings. One of the best safety practices used on Army watercraft is the communication of information. Proper signage is essential as it is a primary way to communicate information to all personnel onboard the vessel.

### **SIGNAGE USED ABOARD ARMY WATERCRAFT**

I-1. On Army vessels, two general types of signs are used: safety and photo-luminescent.

#### **SAFETY SIGNS**

I-2. Safety signs are posted to protect personnel from hazardous situations or areas. Some signs are posted at entry ways while others are posted on specific equipment to warn of hazardous activities or to inform them of specific equipment operation steps. The list below is not all-inclusive.

I-3. Some of the required safety signs are:

- Hearing Protection Required.
- Escape Hatch, Do Not Block.
- Keep Closed.
- No Smoking.
- No Flame.
- High Radiation Hazard.
- Confined Space, Do Not Enter.
- Exit.
- Arrows (Directional).

I-4. Required specific equipment signs:

- Vision Protection Required.
- Wear Protective Clothing (such as gloves, goggles, hardhat or apron).
- No Smoking.
- High Radiation Hazard.
- Fixed Firefighting System Diagrams.
- Emergency Steering Diagrams.

#### **PHOTO-LUMINESCENT SIGNS**

I-5. Photo-luminescent signs are used to identify emergency escape routes, hatches, and some emergency equipment locations. Do not use these signs on exterior locations. The listing below provides a few examples of the required photo-luminescent signs.

- Emergency Escape Breathing Device (EEBD).
- Exit.
- Exit (with direction arrow).
- “Escape Hatch (or Scuttle), Do Not Block”.

I-6. Direction arrows can be made using the tape and cutting pointed ends. These direction arrows are required to be placed between seven (7) and twelve (12) inches from the floor in all interior passageways. Additionally, these arrows can be placed in other spaces to expedite emergency egress from those areas.

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## Appendix J

# Firefighting Techniques

In order to apply proper firefighting techniques it is important to understand the different fire classifications, and the appropriate type of extinguisher to use. It is also equally important to understand the properties and dynamics of each fire classification. Appendix J provides detailed information on the four fire classifications and the extinguishing agents used aboard Army watercraft.

## FIRE EXTINGUISHMENT

J-1. In general, fires may be extinguished by removing one side of the fire Tetrahedron, (fuel, heat, or oxygen or breaking the chain reaction). The method or methods used in any specific instance will depend upon the classification of the fire and the circumstances surrounding the fire. See table J-1 for fire classifications and the type of extinguisher to be used.

**Table J-1. Fire classifications and extinguishing agents**

<b><i>Fire classification</i></b>	<b><i>Examples of types of materials</i></b>	<b><i>Type of Extinguisher</i></b>
Alpha (A)	Wood, paper, cloth, upholstery	Water, class A, B, or C multipurpose dry chemical
Bravo (B)	Flammable liquids, gasoline, jet fuel, paint, oil, grease	Aqueous Film Forming Foam (AFFF),, ABC multipurpose dry chemical, FM-200 CO2, and water fog
Charlie (C)	Electrical equipment and wiring	Carbon Dioxide (CO2), ABC multipurpose dry chemical, and FM-200 is preferred but purple potassium (k) powder (PKP) can also be used
Delta (D)	Combustible metals, such as magnesium, titanium, zirconium, lithium, potassium, and sodium	Jettison from ship or extinguish with special dry powders based on sodium chloride or other salts; also clean dry sand can be used

## REMOVING FUEL

J-2. Although it is not usually possible to remove the fuel to extinguish a fire, there may be circumstances in which it is possible. If part of the fuel that is near or actually on fire can safely be jettisoned over the side, do so as soon as possible. Damage control parties must stand ready at all times to shift combustibles to safe areas. Take whatever measures possible to keep additional fuel away from the fire. In particular, immediately close supply valves in fuel oil, lube oil, and jet propulsion fuel type 5 (JP5) lines.

## REMOVING HEAT

J-3. The fire will go out if you can remove enough heat by cooling the fuel to below temperature at which it will support combustion. Heat may be transferred in three ways as follows:

- By radiation.
- By conduction.
- By convection.

J-4. In the process known as radiation, heat is radiated through the air in all directions. Radiated heat is what causes you to feel hot when you stand near an open fire. In conduction, heat is transferred through a

substance or from one substance to another by direct contact from molecule to molecule. Therefore, a thick steel bulkhead with a fire on one side can conduct heat from the fire and transfer the heat to the adjoining compartments. In convection, the air and gases rising from a fire are heated. These gases can then transfer the heat to other combustible materials that are within reach. Heat transferred by convection is a particular danger in ventilation systems. These systems may carry the heated gases from the fire to another location several compartments away. If there are combustibles with a low flash point within a compartment served by the same ventilation system, a new fire may start.

J-5. To eliminate the heat side of the fire triangle, cool the fire by applying something that will absorb the heat. Although several agents serve this purpose, water is the most commonly used cooling agent. Water may be applied in the form of a solid stream, as a fog, or used together with aqueous film-forming foam (AFFF).

## **CONTROLLING OXYGEN**

J-6. Oxygen is the third component of the fire triangle. Oxygen is difficult to control because you obviously cannot remove the oxygen from the atmosphere that normally surrounds a fire. However, oxygen can be diluted or displaced by other substances that are noncombustible. For example, if a fire occurs in a closed space, it can be extinguished by diluting the air with CO<sub>2</sub> gas. This dilution must proceed to a certain point before the flames are extinguished. The point at which the dilution is enough to extinguish the fire can be reached faster if you quickly secure all ventilation systems to the space. In general, a large enough volume of CO<sub>2</sub> must be used to reduce the oxygen content to 15 percent or less.

## **BREAKING THE CHAIN REACTION**

J-7. Dry chemical fire extinguishing agents do not extinguish fires by cooling or smothering. Instead, they are believed to interrupt the chemical reaction of the fuel and oxygen. This action reduces the rate of combustion, and the fire is extinguished quickly.

J-8. Speed is very important in firefighting. If you allow a fire to burn without confining or extinguishing it, the fire can spread rapidly. A small fire in a trash can may spread to other combustibles and become a large fire that could affect several compartments or even the whole ship. The cost of damage that may have originally been a few dollars could end up costing millions of dollars. Therefore, the ship's fire party must get to the scene with their equipment and start fighting the fire as soon as possible. Any delay that allows the fire to spread will make it more difficult to extinguish the fire with the personnel and equipment available.

## **FIRE-FIGHTING TACTICS**

J-9. As a crew member, you will most likely encounter different types of fires aboard your ship. Although fires have certain things in common, each fire has its own unique features. Examples of some unique features of each fire are the type of material burning, the ease with which the fire can be isolated, or the location of the compartment it is in. With these factors in mind, it is easy to see that there are many things to consider when deciding what tactics to employ to attack a fire. Therefore, fire parties and repair lockers are trained to respond to a variety of situations.

J-10. As you become more proficient in firefighting, combat evolutions, and dealing with engineering casualties, you develop the ability to handle more than one single casualty at a time. Your training prepares you for cascading or multiple casualties, and the opportunity to practice your training should be a learning experience. A mass conflagration is a worst-case scenario. For example, some ships have survived multiple missile hits, others mine explosions and flooding. Your ability to think clearly in the face of multiple casualties may someday save your ship. Creativity counts! For example, firemain ruptures may be jumpered around, or P-100 pumps may replace fire pumps if a casualty occurs to the ship's electrical system. The ability to shore up a weak bulkhead is not learned from a book – you must practice. Do you have the skills to rig casualty power cables to return a vital system to service? There are many such scenarios; keeping your cool and remembering your training is vital to the survival of your ship. Your training prepares you to take on different positions on an attack team, or in a fire party. Should a personnel casualty require a replacement, fire party qualifications allow personnel to replace each other as needed.

J-11. Fire can spread in many different ways. Radiant heat from an intense fire may ignite materials in an adjacent compartment, or it may travel through inoperative ventilation ducts, which failed to shut. Openings between compartments, including cableways, may contribute to the spread of fire. The first sign of the fire spreading is smoke. If you are an investigator, you must constantly rove an assigned area outside the primary fire boundaries. You must also ensure that personnel assigned as boundarymen are well qualified for their job. Report any encounters with smoke outside the primary fire and smoke boundaries; then use your breathing apparatus to investigate, if possible. If the fire spreads, then the secondary boundary becomes the primary boundary, and personnel must attack this new threat to the ship.

J-12. It is the job of the damage control chain of command to make fire-fighting decisions that are based on reports from the scene, from investigators, and from boundarymen. A small fire can become a blazing inferno in a very short period of time, quickly making a compartment or area of the ship uninhabitable. When your ship is underway, you cannot use the strategies and methods used ashore. You cannot wait for the fire department – YOU ARE THE FIRE DEPARTMENT.

## **PROPERTIES AND DYNAMICS OF FIRE**

J-13. There are four classifications of fire and each classification has its own distinct properties and dynamics.

### **CLASS ALPHA FIRE**

J-14. Generally speaking, a class ALPHA fire is any fire in which the burning material leaves an ash. Paper, wood, and cloth are examples of this fuel, and are located throughout your ship. These solid fuels must be heated to their ignition point before they will burn, and there must be enough oxygen to support the fire.

J-15. For a solid fuel to burn, it must be changed into a vapor state. This chemical action is known as pyrolysis and is defined as a chemical decomposition due to the application of heat. This decomposition creates a fuel vapor, which, mixed with oxygen, produces a fire.

J-16. Removal of any one of the three elements of the fire triangle (heat, oxygen, and fuel) will extinguish a fire. A common method of attacking class ALPHA fires is the application of water. The water cools the fuel below its ignition point, thereby removing heat from the fire triangle and thus extinguishing the fire. On larger fires of this type, AFFF will be more effective than seawater. In all such fires, other nearby combustibles (including unseen materials on the other side of that bulkhead) must either be moved or kept cool to prevent further spread of the fire.

### **CLASS BRAVO FIRE**

J-17. A class BRAVO fire presents challenges not encountered in other types of fires. This is because they can be fueled by any of the flammable liquids stored aboard ship, including fuels, liquid lubricants, and solvents. Class BRAVO fires may be extinguished with AFFF, purple-K powder (PKP), or a combination of agents. The single most important step in combating this casualty is to secure the source of the fuel.

J-18. One of the characteristics of a flammable liquid is known as flashpoint, which is the lowest temperature at which the liquid will give off sufficient vapor to form what is known as an ignitable mixture. When mixed with air at this minimum temperature, this vapor will ignite if an ignition source is present.

**WARNING**

**Fuels and other liquids stored aboard ship are often pressurized (to pump them to other areas of the ship), or may be stored under pressure to minimize the release of vapors. Leaks in these pressurized fuel systems will tend to spray outward, and they often atomize, increasing the possibility of coming into contact with an ignition source. As an example, the ignition source could be a heated surface in an engineering compartment or an electrical spark from a faulty electrical component.**

J-19. When flammable liquids spill or leak from a pressurized source, they will cover a large area, release a great amount of vapor, and produce a great amount of heat when ignited. One of the specifications of flammable liquids is that they have a minimum flashpoint. Anytime a ship is refueled, the fuel it receives is tested for both quality and for flashpoint.

J-20. Some flammables require special storage, often in special lockers with temperature detection and sprinkler systems installed. Some of the materials stored in these lockers are paints, welding gases, flammable cleaning solvents, and other materials. An accurate inventory of hazardous materials stored in such lockers should be readily available. Fuels for portable fire-fighting pumps and special small boats may sometimes be stored on the weather decks of the ship.

J-21. Your ship's supply department can provide information about flammable materials (including safety and handling precautions, hazards, and minimum flashpoints). The material safety data sheets have information on each individual hazardous product carried onboard ship.

**CLASS CHARLIE FIRE**

J-22. A class CHARLIE fire is an energized electrical fire, and may be attacked with nonconductive agents such as carbon dioxide or with low-velocity water fog. Special care must be taken to maintain a safe distance from energized equipment. The most common (and safest) method of dealing with a class CHARLIE fire is to secure the electrical power, and treat it as a class ALPHA (burning insulation) fire.

**WARNING**

**Special care must be taken to avoid contact with energized electrical equipment. CO2 bottles must be grounded, and the horn of the portable extinguisher must not come in contact with the energized equipment. If it is necessary to use water fog as an extinguishing agent, a minimum distance of 4 feet must be maintained. A straight stream of water must never be used on a class CHARLIE fire, due to the likelihood of electrical shock.**

**CLASS DELTA FIRE**

J-23. Class DELTA fires are also known as combustible metal fires. This class of fire results when materials such as magnesium, phosphorus, sodium, or titanium are ignited. Certain types of aircraft wheels are manufactured from these materials, as well as various pyrotechnic smokes and flares. Although some ships have pyrotechnic (commonly referred to as "pyro") magazines below decks, typically most occurrences of DELTA fires happen topside, where storage is more common.

J-24. Pyrotechnics often contain their own oxidants and therefore do not depend on atmospheric oxygen for combustion. For this reason, the exclusion of air, such as by use of PKP, foam, or other extinguishers, will typically be ineffective.

### **WARNING**

**Class DELTA fires burn with an intense heat of up to 4,500°F, and action must be taken to shield your eyes from the brilliance of the flame. High velocity fog should be used to cover and cool these fires. If possible, remove the burning material by jettisoning it over the side of the ship. To prevent the fire from spreading, you should apply large quantities of water at low pressure to cool the surrounding area. Class DELTA fires give off extreme amounts of heat and can produce explosions. Therefore, you must maintain a safe distance from the source of the fire while applying the water fog.**

### **WARNING**

**During a class DELTA fire, certain chemical reactions are occurring as the water is applied to cool the surrounding area. This water reacts with the burning metal and forms hydrogen gas, which will either burn or explode, depending on the intensity of the fire and the amount of burning material. In any case, maintain a safe distance from the fire and shelter yourself and your team from any potential explosions.**

## **EXTINGUISHING AGENTS**

J-25. The extinguishing agents commonly used by watercraft fire fighters include the following:

- Water.
- Aqueous film-forming foam (AFFF).
- Purple-Potassium (K)-Powder (PKP).
- Carbon Dioxide (CO<sub>2</sub>).

J-26. The agent or agents that are used in any particular case will depend upon the classification of the fire and the general circumstances.

### **WATER**

J-27. Water is a cooling agent, and onboard ship the sea provides an inexhaustible supply. If the surface temperature of a fire can be lowered below the ignition temperature of the fuel, the fire will be extinguished. Water is most efficient when it absorbs enough heat to raise its temperature to 212°F (100°C). At this temperature, the seawater will absorb still more heat until it changes to steam. The steam carries away the heat and results in the lowering of the temperature of the surface.

### **AQUEOUS FILM-FORMING FOAM**

J-28. Foam is a highly effective extinguishing agent for smothering large fires, particularly those in oil, gasoline, and jet fuels. AFFF, also known as “light water,” is a synthetic film-forming foam designed for use in shipboard fire-fighting systems. The foam proportioning/injection equipment generates a white foam blanket.

J-29. AFFF is equivalent to seawater when it is used to extinguish class Alpha fires. The unique action of AFFF stems from its ability to make a light water film float on flammable fuels. As foam is applied over the flammable liquid surface, an aqueous solution drains from the foam bubbles and floats out over the surface to provide a vapor seal. This aqueous film-forming action enhances extinguishment and prevents reflash, even when the foam blanket is disturbed. Fuels which have not been ignited may also be protected with this same action. AFFF can be used alone or in combination with PKP.

## PURPLE-K-POWDER

J-30. Dry chemical powders extinguish a fire by a rather complicated chemical mechanism. They do not smother the fire and they do not cool it. Instead, they interrupt the chemical reaction of the fire by suspending fine particles in the fire. In effect, the dry chemicals put a temporary screen between the heat, oxygen, and fuel and maintain this screen just long enough for the fire to be extinguished. Several types of dry chemicals have been used as fire extinguishing agents. For watercraft use, the most important agent of this kind at present is potassium bicarbonate, also known as PKP. PKP is used to extinguish class B and class C fires because it is very effective against these fires. However, it is both corrosive and abrasive and should be used on class C fires only in emergencies. PKP is available in 18-pound and pound portable extinguishers. PKP can be used in conjunction with AFFF.

## CARBON DIOXIDE

J-31. Carbon dioxide (CO<sub>2</sub>) is an effective agent for extinguishing fires by smothering them; that is, CO<sub>2</sub> reduces the amount of oxygen available for combustion. This smothering action is temporary and you must remember that the fire can quickly rekindle if oxygen is again admitted to the hot embers.

J-32. CO<sub>2</sub> is a dry, noncorrosive gas that is inert when in contact with most substances. It is heavier than air and remains close to the surface. CO<sub>2</sub> does not damage machinery or other equipment. Since it is a nonconductor of electricity, CO<sub>2</sub> can safely be used to fight fires that might present electric shock hazards. However, the frost that collects on the horn of a CO<sub>2</sub> extinguisher does conduct electricity. Therefore, you should be careful and never allow the horn to come into contact with electrical components. Aboard ship, CO<sub>2</sub> fire extinguishing equipment includes 15-pound CO<sub>2</sub> extinguishers, 50-pound CO<sub>2</sub> hose and reel installations, and 50-pound CO<sub>2</sub> installed flooding systems. Although CO<sub>2</sub> is nonpoisonous, it is dangerous because it does not provide a suitable atmosphere for breathing. Asphyxiation can result from breathing CO<sub>2</sub>; therefore, an oxygen breathing apparatus (OBA) must be worn when CO<sub>2</sub> is used below decks or in confined spaces.

J-33. Remember, no two fires are identical; you will have to determine the best method or extinguishing agent to use when fighting a fire. Safety is to be observed always.

## TESTING

J-34. Title 46 CFR 147.65 mandates that carbon dioxide cylinders forming part of a fixed fire extinguishing system must be retested, at least, every 12 years. If a cylinder is discharged and more than five years have elapsed since the last test, it must be retested before recharging.

J-35. Table J-2 below and continuing on page J-7 was taken from Title 49 CFR 180.209 and lists the requirements for periodic qualification of cylinders.

**Table J-2. Qualification of cylinders**

<i>Specification under which cylinder was made</i>	<i>Minimum test pressure shown in pounds per square inch gauge (psig)</i>	<i>Qualification period (years)</i>
Department of Transportation (DOT) 3	3000 psig	5

**Table J-2. Qualification of cylinders (continued)**



<b><i>Specification under which cylinder was made</i></b>	<b><i>Minimum test pressure shown in pounds per square inch gauge (psig)</i></b>	<b><i>Requalification period (years)</i></b>
DOT 3A, 3AA	5/3 times service pressure, except non-corrosive service (see Title 49 Code of Federal Regulations (CFR) 180.209 (g)).	5, 10, or 12 (see Title 49 CFR sections 180.209(b), (f), (h), and (j))
DOT 3AL	5/3 times service pressure	5 or 12 (see Title 49 CFR 180.209 (j) and (m))
DOT 3AX, 3AAX	5/3 times service pressure	5
3B, 3BN	2 times service pressure (see Title 49.CFR 180.209(g))	5 or 10 (see Title 49 CFR 180.209(f))
3E	Test not required	Not Applicable
3HT	5/3 times service pressure	3 (see Title 49 CFR 180.209(k) and 180.213(c))
3T	5/3 times service pressure	5
4AA480	2 times service pressure (see Title 49 CFR 180.209(g))	5 or 10 (see Title 49 CFR 180.209(h))
4B, 4BA, 4BW, 4B-240ET	2 times service pressure, except non-corrosive service (see Title 49 CFR 180.209(g))	5, 10, or 12 (see Title 49 CFR 180.209(e), (f), and (j))
4D, 4DA, 4DS	2 times service pressure	5
DOT 4E	2 times service pressure, except non-corrosive service (see Title 49 CFR 180.209(g))	5
4L	Test not required	
8, 8AL	N/A	10 or 20 (see Title 49 CFR 180.209(i))
Exemption or special permit cylinder	See current exemption of special permit	See current exemption or special permit

## DYNAMICS OF A FIRE

J-36. The fact that there is a large variety of materials aboard any vessel which can burn and should be considered as fuels cannot be overemphasized. As stated before, for a solid fuel to burn, it must be changed into a vapor state. This chemical action is known as pyrolysis and is defined as a chemical decomposition due to the application of heat. This decomposition creates a fuel vapor. When this vapor is mixed with oxygen at the right temperature, a fire is produced.

J-37. A solid fuel will burn at different rates depending upon its size and configuration. For example, a pile of wood chips or wadded paper will burn faster than an equal amount of solid wood or a case of paper. This fact is true because there is a larger surface area exposed to the heat; therefore vaporization occurs faster. Because more vapor is available for ignition, the fire burns more intensely and the fuel is consumed at a faster rate.

J-38. A liquid fuel releases vapor much as a solid fuel does. However, it does so at a higher rate and over a larger temperature band. Because liquids have more loosely packed molecules, heat increases their rate of vapor release. These dynamics result in the fact that pound-for-pound liquid fuels produce about 2 ½ times more heat than wood, and this heat is given off much more rapidly.

J-39. If a flammable liquid is spilled (or is atomized and sprayed out under pressure) it covers a very large surface area and gives off much more vapor. This is one reason flammable liquid (class BRAVO) fires burn so violently.

J-40. As mentioned earlier, the lowest temperature at which a liquid gives off sufficient vapor to form an ignitable mixture is known as the flashpoint for that liquid. An ignitable mixture is a mixture of vapor and air that is capable of being ignited by an ignition source. As an example, gasoline has a flashpoint of -45°F (-43°C). This factor makes gasoline a constant hazard because it produces flammable vapor at normal temperatures. Like gasoline, the other shipboard fuels have specified minimum flashpoints.

J-41. To ignite, a flammable gas or vapor of a liquid has to mix with air in the proper proportion. The lowest percentage of gas that will make an ignitable mixture is called its lower explosive limit (LEL). If there is less vapor or gas than this percentage, then the mixture is too lean to burn. Conversely, there is also an upper explosive limit (UEL) above which the mixture is too rich to burn.

J-42. Table J-3 below and continuing on page J-9 shows the flashpoint, LEL, UEL, and ignition temperature for a few of the flammable materials carried aboard ship. As an example, a mixture of 10% gasoline vapor and 90% air will not ignite, because the mixture is too rich (above the UEL). In this case a large amount of air must mix with a small amount of vapor to form an ignitable mixture. The range between the lower and upper explosive limits is called the explosive range of the gas (or vapor).

**Table J-3. Properties of selected flammable liquids and gases**

<i><b>Material</b></i>	<i><b>Flashpoint</b></i>	<i><b>Lower Explosive Limit (LEL)</b></i>	<i><b>Upper Explosive Limit (UEL)</b></i>	<i><b>Ignition Temp</b></i>
Acetylene	Gas (1)	2.5%	100%	581F (305C)
Carbon Monoxide	Gas (1)	12.5%	74.0%	1128F (609C)
Cooking Oil	610 F (6)	(3)	(3)	740F-830F(6) (393C – 443C)
Ethyl Alcohol	55F (13C)	3.3%	19.0%	685F (363C)
Fuel, Navy Distillates (F-76) (MIL-F-16884)	140F (60C)	(2)	(2)	450F (232C)
Gasoline (100 Octane)	-45F (-43C)	1.4%	7.6%	853F (456C)
Hydraulic Fluid Mil-H-17672: 2075 TH	315F (157C)	(3)	(3)	
2110 TH	325F (163C)	(3)	(3)	658F (363C)
2135 TH	340F (171C)	(3)	(3)	
Hydrogen	Gas (1)	4.0%	75.0%	932F (500C)
JP-4 (MIL-T-5624)	0F (-18C) Naval Ships' Technical J-3.Manual Chapter 542	1.3%	8.0%	464F (240C)
JP-5 (MIL-T-5624)	140F (60C)	0.6%	4.6%	475F (246C)
JP-8	100F (38C)	0.7%	5.0%	444F (229C)
Lubricating Oil: 2190 TEP (MIL-L-17331)	400F (205C)	0.9%	7.0%	(4)
9250 (MIL-L-9000)	380F-390F (193C-199C)	(3)	(3)	

**Table J-3. Properties of selected flammable liquids and gasses (continued)**

<i>Material</i>	<i>Flashpoint</i>	<i>Lower Explosive Limit (LEL)</i>	<i>Upper Explosive Limit (UEL)</i>	<i>Ignition Temp</i>
Methane (5)	Gas (1)	5.0%	15.0%	999F (537C)
Methyl Alcohol	52F (11C)	6.7%	36%	725F (385C)
Methyl Ethyl Ketone	16F (-9C)	1.4%	11.4%	759F (404C)
Propane	Gas (1)	2.1%	9.5%	842F (450C)
Torpedo Otto Fuel II	265F (129C)	(3)	(3)	
<b>Notes to Table J-3</b>				
1) Flammable gases do not list flashpoints since they can be ignited at any temperature (2) Explosive limits of Fuel, Navy Distillate (F-76) are similar to those of JP-5. (3) Data for LEL and UEL not available. (4) Data Unavailable. (5) Methane exists in and around the Collection, Holding and Transfer (CHT) and Vacuum Collection, Holding, and Transfer (VCHT) systems. (6) Cooking oil flashpoint and ignition temperatures vary with origin of oil, brand, age, and contaminants.				

## FIRE GROWTH

J-43. There are four distinct stages in the growth of a fire within a compartment of a ship. These stages are known as (1) growth, (2) flashover, (3) fully-developed fire, and (4) decay. See figure J-1 for how air temperature and time affect these stages.

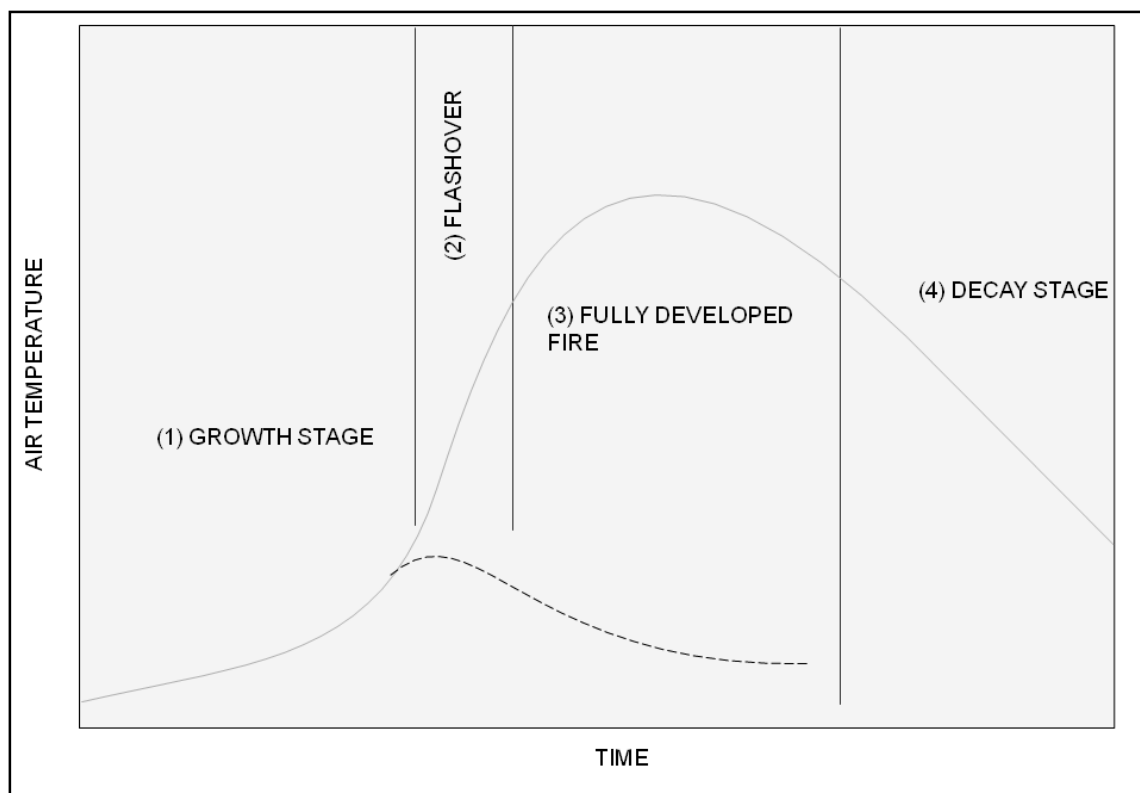


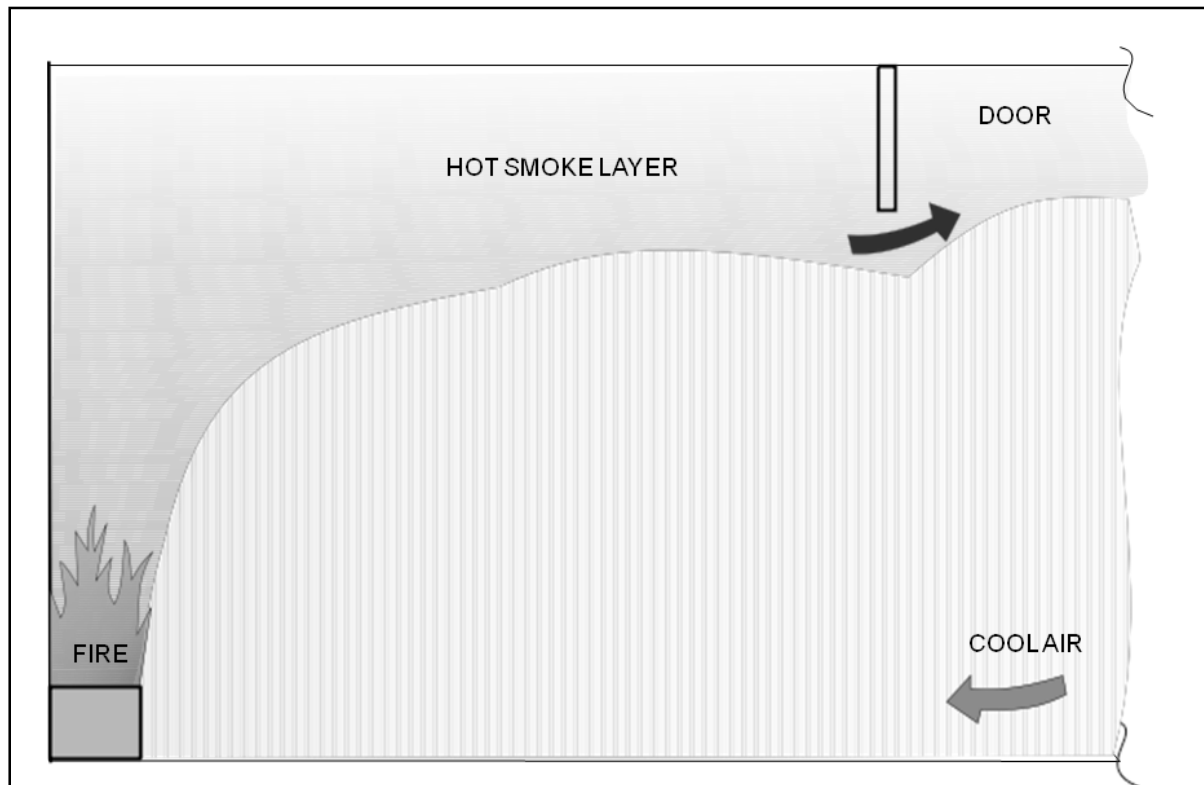
Figure J-1. Stages of compartment fire growth

J-44. During the growth stage of a fire (see figure J-2), the average space temperature is low and the fire is localized near the area where it started. It is hot in the immediate vicinity of the fire, and rising heat and smoke create a hot upper level in the compartment.

J-45. As the available fuels and combustibles in the space are consumed the fire begins to decay. In the decay stage, combustion slows down (decays) and finally the fire goes out.

J-46. There are significant exposure thresholds for human tolerance to heat as shown in table J-4 on page J-11 and continuing on page J-12, along with other temperature characteristics that may help you put them in perspective.

J-47. If a fire goes out quickly due to a lack of oxygen, such as in a tightly sealed compartment, fuel vapors may still be formed from any flammable liquid that is heated above its flashpoint. If fresh air is allowed into the space before this fuel vapor cools below its flashpoint, this mixture can ignite explosively. This is known as backdraft, and fortunately, is an unusual occurrence.



**Figure J-2. Growth stage of a compartment fire**

## **FIRE SPREAD**

J-48. In what is called the “rollover” of a compartment fire, a flame front of burning gases is formed across the overhead of the space. Rollover takes place in the growth stage when unburned combustible gases from the fire mix with fresh air in the overhead and begin burning at some distance from the fire. Rollover differs from flashover in that only gases are burning in the space.

J-49. The flashover stage is the period of transition from the growth stage to the fully-developed fire stage. It occurs in a short period of time and may be considered an event, much as ignition is an event in a fire. It normally occurs at the time the temperature of the upper smoke layer reaches 1100°F (600°C). The most obvious characteristic of flashover is the sudden spreading of flame to all remaining combustibles in the space. Personnel still in the compartment when flashover occurs are not likely to survive.

J-50. In the fully-developed fire stage all flammable materials in the compartment have reached their ignition temperature and are burning. The rate of combustion will normally be limited by the amount of oxygen available in the air to provide combustion. Flames may emerge from any opening; hatches, open ventilation ducting. Unburned fuel vapor in the smoke may flash when it meets fresh air in adjacent compartments. There may be structural damage to bulkheads or decks when exposed to these extreme temperatures. A compartment may reach the fully-developed fire stage very quickly during machinery space flammable-liquid fires or during enemy weapon-induced fires.

J-51. If space personnel attack a fire early and efficiently, it can be confined to the area in which it started. If the fire continues to burn unchecked, it can generate great amounts of heat that will travel away from the fire area, starting more fires wherever fuel and oxygen are available. Steel bulkheads and decks and other fire barriers can delay but not prevent heat transfer.

J-52. When a fully-developed fire exists in a compartment, the fire is most quickly spread to other compartments through openings such as doorways, vent ducts, and unsealed cableways. It will also spread to adjacent compartments by heat conduction through the bulkheads. Fires normally spread faster upward to the space above than to adjacent horizontal spaces simply because heat rises.

J-53. Tests have been developed to provide typical temperatures, radiant heat flux, and length of time for material ignition by conduction through steel bulkheads from a fully-developed fire. The compartments tested were 8-foot x 8-foot x 8-foot steel cubes with bare metal surfaces. These typical values shown will differ based on the space that the fire is in, due to factor such as bulkhead insulation, compartment dimensions, ventilation, specific material characteristics, and water application and cooling.

J-54. Fire may spread through bulkhead penetrations such as electrical cableway openings. Although these openings are sealed, experience has shown that even armored cables will burn from extreme heat. Cableway fires may be hard to extinguish because they are difficult to cool because the grouping of multiple cables traps and contains heat. Also, cableways are often run through the overhead of compartments, and heavy smoke hinders finding the source of the fire. Older-style electrical cables will generate toxic black smoke from their insulation. Newer cables in use aboard ship are designed to reduce the amount of smoke generated.

**Table J-4. Ignition thresholds**

Ignition thresholds (Pilotless ignition within 30 seconds)			
Material	Hot air (Oven effect)	Hot metal contact (Frying pan effect)	Radiant heat flux
Paper	450 F (230 C)	480 F (250 C)	20 kilowatts per minute squared (kW/m2)
Cloth	480 F (250 C)	570 F (300 C)	35 kW/m2
Wood	570 F (300 C)	660 F (350 C)	40 kW/m2
Cables	700 F (370 C)	840 F (450 C)	60 kW/m2
Ignition of paper via radiant heat			
Radiant heat flux		Time to ignition	
20 kilowatts per square meter (kW/m2)		25 seconds	
25 kW/m2		14 seconds	
35 kW/m2		8 seconds	
50 kW/m2		3.5 seconds	
75 kW/m2		2.5 seconds	
Hot air exposure		Human tolerance to heat	
200 F (190 C)		Incapacitation 35 minutes, death in 60 minutes	
300 F (150 C)		Incapacitation 5 minutes, death 30 minutes	
380 F (190 C)		Immediate incapacitation, death 15 minutes	

Table J-4. Ignition thresholds (continued)

<i>Hot air exposure</i>	<i>Human tolerance to heat</i>
400 F (200 C)	Irreversible respiratory tract damage
650 F (340 C)	Death
<i>Radiant heat exposure</i>	<i>Human tolerance to radiant heat</i>
1 kW/m <sup>2</sup>	Noon sun radiation on clear sunny day
5 kW/m <sup>2</sup>	Pain threshold for exposed skin
10 kW/m <sup>2</sup>	Immediate blistering
<i>Electronic heat threshold</i>	<i>Thermal effects on electronics</i>
120 F (50)	Computers develops faults
300 F (150 C)	Permanent computer damage
480 F (250 C)	Data transmission cables fail

## TYPE OF ATTACK

J-55. Many factors go into the decision-making process to size up a fire, and information is vital. The location, type, and size of the fire, available resources (including personnel), and fire growth all determine the overall plan of attack. Reports from the scene will include (1) location of fire, (2) class of fire, (3) action taken to isolate and combat the fire, (4) fire contained, (5) fire out, (6) reflash watch set, (7) fire overhauled, (8) compartment ventilated (9) compartment tested for oxygen, (10) compartment tested for flammable gases, and (11) compartment tested for toxic gases. If a chemical, biological, and radiological (CBR) threat exists, reports should include any CBR contamination and condition of CBR boundaries.

J-56. Much of the initial information about a fire will come from evacuating watchstanders. Space personnel will evacuate when they are endangered, or the fire goes out of control. Every attempt must be made to account for all space personnel, since they may not all evacuate through the same exit. All evacuees will muster at a pre-arranged location outside of designated smoke and fire boundaries. Missing personnel must be reported to the bridge. Use of bilge sprinkling activation (if installed) is documented, including time of activation.

J-57. Other information may come from boundarymen or investigators. A boundaryman is responsible for observing a particular bulkhead or deck for signs of heat, such as smoldering or blistering paint, or smoke (particularly through bulkhead or deck penetrations). The boundaryman will attempt to cool the bulkhead to prevent spread of the fire as necessary. The investigators travel prearranged routes ensuring that fire and smoke boundaries are set, and making ongoing reports to their associated repair locker. When smoke is encountered, the investigators will immediately report it and don their OBAs prior to further investigation. Various circuits are available for the investigators to use to make reports, and many ships have hand-held radios for damage control use.

## AFFECTED/DAMAGED SYSTEMS

J-58. The information necessary to effectively combat a large fire must include an assessment of any damage to fire-fighting systems, as well as any major systems within the compartment that are not isolated and electrical isolation. The decision to secure compartment lighting rests with the on-scene leader.

## FIRE AND SMOKE BOUNDARIES

J-59. Fire and smoke boundaries are determined for each of the large engineering spaces aboard your ship. The ship's fire doctrine lists both primary and secondary boundaries. The boundaries are designed to effectively contain a fire to prevent its spread.

J-60. Primary fire and smoke boundaries are set at all bulkheads immediately adjacent to the fire. Boundrymen will man these primary boundaries with a fire hose, and may have to cool the bulkhead to prevent spread of the fire. Fire could spread through any penetration, including ventilation, electrical cableways, piping conduits, or defective welds in cases of extreme heat.

J-61. A secondary set of boundaries is set at the next immediate watertight bulkhead from the scene. If a boundary fails, and the fire cannot be contained at the first boundary, the boundaryman will attempt to secure the space and evacuate. What were previously secondary boundaries now become the primary boundaries. Boundary information is plotted by the bridge and all repair lockers.

## Smoke Control

J-62. Smoke control is comprised of the following areas.

- Ventilation. The operation of ventilation systems is described where required in this manual. Each ship shall supplement its SOP with a list of fans and their controls to be secured for a designated fire and buffer zone. Weather deck supply intake and exhaust discharge locations shall be listed. The location of controllers, their designation, and area served shall also be listed.
- Smoke Boundaries. The use of smoke boundaries around the affected space can effectively limit the spread of smoke and provide controlled areas for the staging of firefighting personnel. They shall be set quickly using, as a minimum, fume tight boundaries which each ship shall clearly identify. The objective of primary smoke boundaries is to first establish a buffer zone by closing those hatches and doors immediately adjacent to the access for the affected space. Smoke curtains may be used where hatches and doors may be required to remain open for firefighting purposes. This buffer zone shall be a dead-air area. Only personnel with Breathing Apparatus (BA) are allowed to enter this area once it is established. BAs should be used when smoke is present or when ordered by the scene leader. A second boundary shall be set around the buffer zone to check the spread of smoke and provide a safe area for firefighting personnel without BAs. Each ship shall supplement its SOP with a list of designated smoke boundaries for machinery spaces.
- Maintaining Fire and Smoke Boundaries. Once a machinery space has been evacuated, fire and smoke boundaries should be maintained. At the time of reentry, firefighters may encounter a back draft explosion as accesses to the affected space are opened and hot fire gases are relieved onto the damage control deck. Firefighters should use caution to position themselves to the side of the access when the door, hatch, or scuttle is initially opened.

## Space Isolation

J-63. The complete isolation of the affected space, with the exception of lighting, is necessary to prevent a fire from intensifying due to the addition of flammable liquids and oxygen, and to reduce the electrical hazards. Each ship shall supplement its Standard Operating Procedures for shipboard emergencies with a list of local and remote controls (valves, switchboards, circuit breakers, and so forth), for rapid space isolation. The designation, location, function, and area served by each control shall be provided.

J-64. The following areas shall be considered when isolating the space:

- Mechanical. Every effort shall be made to secure and isolate those systems, machinery, and tanks that have the potential to feed or otherwise contribute to the intensity of the fire. These include, in priority, those systems where action should first be taken.
- Fuel transfer, service and stripping pumps, and centrifugal purifiers.
- Fuel systems, storage, and service tanks.
- Lube oil pumps and centrifuge purifiers.
- Hydraulic systems.
- Lube oil tanks.
- Air compressors.

- Electrical. To the extent possible, all electrical equipment, with the exception of lighting, shall be secured from outside the affected space at the ship's service, and emergency switchboards, load center, or distribution panel. The switches, circuit breakers, and fuses necessary to do this shall be clearly identified.
- Fire Boundaries. Fire Boundaries shall be established around the affected space to contain the fire and ensure designation of adjacent spaces to be observed for hot bulkheads. These boundaries are generally the watertight bulkheads and decks immediately adjacent to the affected space. The minimum degree of tightness for a fire boundary is fume tight. The ship may set general quarters to rapidly establish fire boundaries. Each ship shall supplement its Standard Operating Procedures for shipboard emergencies with a list of designated fire boundaries for machinery spaces.
- Fuel Tanks. Transfer of fuel to a safe location to remove fuel tank contents puts the empty fuel tank at maximum risk to fire. Therefore, transfer of fuel from the fire area should not be attempted. In summary, the only action necessary to prevent tank contents from contributing to a machinery space fire is to isolate and secure the fuel system.

J-65. When initiating action to secure and isolate the foregoing, the following factors shall be considered:

- Not all of the above have remote securing or isolation capability. As such, much local securing or isolating shall be accomplished as soon as possible together with the start of firefighting actions. As a minimum, local securing of systems shall include tank and bulkhead boundaries. Familiarity with location and type of local securing and isolating capabilities, and casualty control procedures such as those contained in the applicable propulsion plant manuals is required.
- Where remote capability is provided for any of the above, it is most likely located within or immediately adjacent to the access to engineering operating station and at the access to the machinery space on the damage control deck. Ensure system isolation by visual or operational verification of all remote actuators.
- Care shall be exercised to prevent cascading casualties to equipment in unaffected spaces necessary to maintain propulsion, electrical power, and fire main pressure. Air systems, air compressors, and fuel tanks located close to space boundaries are of particular concern. Communication with other machinery spaces is essential to reduce the potential for casualties.

## **REPORTS (FM 200, BILGE SPRINKLING)**

J-66. Reports by evacuating personnel will include whether bilge sprinkling was used, and whether the source of the fire (such as leaking or spraying fuel) was secured, and whether FM 200 was activated.

J-67. Investigators will attempt to determine whether FM 200 was effective by observing the color of smoke inside the space through the battle ports at the escape trunk. Smoke color may also be observed from topside, if the space is not completely air-tight, and reported to bridge. These reports help make the determination whether to immediately re-enter to combat the fire, or if it is already out, to allow the space to cool prior to entry.

## **PREPARING TO ENTER THE SPACE**

J-68. If you are a scene leader, your primary source of information is your locker leader. The locker leader maintains plots of all damage control information throughout the ship, and will pass along all pertinent information to the scene leader. You are responsible for briefing your personnel and giving them the necessary information, so they will be better prepared to deal with conditions inside the compartment.

## **BRIEFING HOSE TEAMS**

J-69. Some of the information that hose teams must be briefed on are as follows: (1) status of the fire to include location, type of fire (and is it still burning), was FM 200 effective; (2) status of the compartment: extent of major damage, equipment status, mechanical isolation, electrical isolation, boundaries; (3) watchstanders not accounted for; (4) activation of bilge sprinkling; and (5) planned method of attack.



J-70. The vessels main space fire doctrine provides a basic checklist for various personnel actions and is tailored to each vessel. Other information may be important as well, depending upon the vessels configuration or additional casualties to the vessel or systems.

## DRESSING OUT

J-71. You and other attack team personnel will assist each other as necessary while donning personal protective equipment. You must ensure that your shipmate is properly dressed out. Personal protective equipment is intended to fit slightly loosely, especially gloves. This ensures that your skin has room to move somewhat inside this clothing. It also helps to keep hotter areas of the clothing from remaining in constant contact with your skin. This practice also reduces the likelihood of heat stress by allowing some air movement within the confines of the firefighter's ensemble (FFE).

## CHECKING EQUIPMENT

J-72. When donning a SCBA, you should examine it and ensure it has not been damaged while in storage.

J-73. The naval fire fighter's thermal imager (NFTI). The NFTI is a device that allows the user to see through dense smoke and light steam by sensing the difference in infrared radiation given off by objects with a temperature difference of at least 4 degrees Fahrenheit. A small television-type monitor is built into the back of the NFTI, and displays these variations in temperature as a black and white image. Hotter objects will appear lighter on the screen than cooler objects. The NFTI has multiple uses, including locating the seat of a fire, locating injured personnel, and searching for hangfires and hotspots.

J-74. If the NFTI will be used, it must be warmed up in accordance with the manufacturer's technical manual. Because it is very fragile, only qualified personnel will handle the NFTI. Most team leaders carry a spare battery for the NFTI. Helmet lights, handheld radios, voice amplifiers, and handheld firefinders are among the equipment that should be checked prior to re-entry.

J-75. The NFTI is battery-operated and displays five light emitting diodes when fully charged. A good practice is to change the battery when more than one light goes out during use. To conserve battery power, turn the NFTI off when not in use, and allow 1 minute for warm-up prior to use.

J-76. The NFTI has two modes of operation; pan and chop. The pan mode provides the greater sensitivity; however, the NFTI must be kept in motion or the image will fade out. The chop mode is best for firefighting, allowing the user to focus on one area while holding the NFTI still. A blue button on the front of the NFTI allows you to change modes. Prior to compartment entry, you must ensure the NFTI is in the chop mode.

J-77. When using the NFTI, it has been proven that slow, steady advancement; along with periodic scanning of the scene during an approach, helps the operator judge distances better. A side-to-side scan also provides important information on hazards in the area and the best direction in which to proceed. An occasional vertical scan will detect hazards above deck level, such as cableway or overhead fires.

## FIRE-FIGHTERS ENSEMBLE

J-78. The firefighter's ensemble consists of fire-fighter's coveralls, fire-fighter's hood, damage control/fire-fighter's helmet, fire-fighter's gloves, and fireman's boots, all designed to protect the fire fighter from the heat generated by a growing (pre-flashover) fire. For a flashover or fully-developed fire, the FFE provides only a few seconds of protection for escape. The fire-fighter's glove size should be selected for a loose hand and finger fit to reduce heat transfer from continuous material contact and allow glove adjustment at hot points. Additional hand protection can be gained by wearing a flash glove as an extra inner liner to an oversized fire-fighter's glove. While waiting to enter the fire area, the FFE coveralls should only be donned to the waist, tying the coverall arms around the waist.

## ACCESSING THE SPACE

J-79. Proper fire boundaries must be set prior to accessing the affected compartment, to provide a safe area from which fire fighters can attack the fire. Electrical isolation must be complete prior to re-entry; the only exception is lighting. The on-scene leader will decide whether to secure compartment lighting. Complete

electrical isolation helps to decrease the number of ignition sources inside the compartment. Mechanical isolation does not have to be complete prior to re-entry; however, it does provide greater safety for firefighters.

J-80. Prior to space re-entry, there may be evidence that FM 200 and bilge sprinkling was not effective. If available, activate AFFF bilge sprinkling for 2 minutes prior to entry.

## **ATTACKING A FIRE**

J-81. There are different methods for attacking a fire; however, no single tactic or strategy is applicable to every situation. For example, in a multiple hose attack, it is possible to drive smoke and flames away from one hose team onto another team. Therefore, all attacks must be coordinated.

J-82. One of the dangers of opening an access to a compartment is that fresh oxygen is introduced into the space. If space temperatures are above the auto-ignition point of any combustible materials, they may start burning again once fresh air reaches them. This is the reason for allowing a cool down period.

## **DIRECT ATTACK**

J-83. The ideal method of attacking a fire is a direct attack. This technique involves short bursts with a narrow fog or direct stream, as directed by the team leader. Fire fighters advance into the immediate fire area and apply AFFF directly onto the fire.

J-84. The type of attack is determined from all information received. A direct attack is the ideal method of attacking a fire. Upon entering the compartment, the hose team proceeds to the seat of the fire, and attacks it "directly." Other direct attacks involve a fog attack into the overhead gases, or a direct attack upon the base of the fire from the compartment entrance. The accessman opens the hatch or door so that fire fighters can enter the compartment. If a fire has burned for a considerable time, the access hatch to the compartment may be jammed. It may be necessary to use forcible entry equipment, including bolt cutters, sledge hammers, and pry bars.

## **INDIRECT ATTACK**

J-85. An indirect attack is used when conditions do not allow fire fighters to enter the space. A fog spray is introduced from a cracked doorway or any available penetration. Upon completion, fire fighters will then enter the compartment and attack the fire directly. Compartment venting is another means of cooling the space so fire fighters may enter safely. An opening leading directly to an open weather deck area (or a large open compartment leading directly outside) allows the hot gases overhead to vent. It may be desirable to cut a hole in the overhead leading outside. This hole should be at least 1 square foot in diameter to allow proper venting. Prior to entry, bilge sprinkling (if installed) will be activated for 2 minutes.

## **LOSS OF PERSONNEL**

J-86. Training prepares individuals to take on different positions on an attack team, or in the fire party. A personnel casualty requires you to find a replacement for that person. Battle damage may prevent a member of the fire party from reaching his or her general quarter station. The key element is training, enabling personnel to perform a variety of functions in the fire party.

## **FIRE ATTACK AND HOSE HANDLING**

J-87. When inside a compartment that is on fire, the attack team leader coordinates the movements of the attack team. The leader passes and receives information by means of the personnel manning the hose, who relay the message to the next person on the hose.

## **HOSE TEAM MOVEMENTS**

J-88. The first obstacle for a hose team member is often a ladder leading downward. For safety, only one person should be on the ladder at a time. As the nozzleman advances, the hose team members pass the hose

down to him while he descends the ladder. After he reaches the deck, the first hoseman will descend the ladder, followed by another hoseman, as needed to handle the hose. As the hose progresses further into the space, more hose is needed, as well as hosemen.

J-89. The attack team leader usually operates the NFTI, looking for hotspots and hangfires. Although the team leader already knows the location of the seat of the fire, he must be alert to the likelihood that other parts of the compartment are on fire. The leader must also look for obstructions that prevent advancing to the seat of the fire. The team leader will also issue orders for hose advancement, and instructs the nozzleman to attack the fire with the necessary spray pattern.

J-90. Hosemen follow the direction of the team leader, moving forward on the hose, advancing or backing up with the hose, and handling the weight of the hose. Whenever the nozzle is opened, a recoil effect pushes the hose backwards, and hosemen will push forward to compensate for this.

## **LOCATING THE SEAT OF A FIRE**

J-91. All members of the fire party have been briefed regarding the location of the fire from information received from space evacuees. Finding the seat of the fire probably will not be too difficult; reaching it may be another matter. In extreme temperature conditions, deck plates may warp, or ladders may fail. Move throughout the compartment with extreme caution.

## **EXTINGUISHMENT**

J-92. Once the team leader and nozzleman have successfully reached the seat of the fire, the team leader directs the nozzleman in foam application to extinguish any remaining fire. Different spray patterns from the hose nozzle are used as needed, either to break up any combustible material, or to cover a certain area with AFFF.

## **PREVENTION OF REFLASH**

J-93. AFFF is particularly effective against class BRAVO fires, because it serves three distinct functions. As foam it floats on top of flammable liquids, preventing vapors from being released to the atmosphere. This foam also prevents oxygen from reaching the flammable liquid. The AFFF foam, being a mixture of concentrate and water, also provides a cooling effect. Therefore, covering hot spots with AFFF is highly effective in preventing reflash. Allowing the compartment to cool down prior to reentry also helps to prevent reflash.

## **REFLASH WATCH**

J-94. Once satisfied that the original fire is extinguished, the team leader stations a reflash watch. The person assigned as reflash watch remains near the seat of the fire with a charged hose, and observes the area to ensure that no new fire breaks out. Normally at least one other hoseman remains on scene with the nozzleman to tend the hose in case a reflash occurs.

## **HANGFIRES AND OVERHAUL**

J-95. Once the reflash watch is set, the team leader and a second hose team search for hangfires. All areas of the compartment are examined with the NFTI, ensuring that no areas are missed. All cableways, areas beneath deck plates, and overheads are examined to ensure no hangfires are missed. At various times, the team leader will make reports detailing percentage of overhaul. If hangfires are found, they are extinguished. It is sometimes necessary to use overhaul equipment to pull smoldering or burning material (such as lagging) from an overhead or bulkhead in order to extinguish it.

## **DESMOKING AND ATMOSPHERIC TESTING**

J-96. Once a fire is extinguished, specific actions must be taken to return the compartment or space damaged by the fire to a condition suitable for remanning. These actions include the following: desmoking, atmospheric testing, dewatering, and a thorough follow-up inspection.

## **DESMOKING**

J-97. Active desmoking is the process of removing smoke and heat from the buffer zone prior to extinguishing a fire. This action aids fire-fighting efforts, and helps prevent the spread of smoke throughout the ship. Desmoking may be accomplished using ventilation fans in adjacent compartments or with portable fans. There will be some smoke in surrounding areas; smoke boundaries will help slow the spread of smoke. This type of desmoking should not be confused with the desmoking process of the affected compartment after the fire has been overhauled.

J-98. When a class BRAVO fire has been extinguished, combustible gases may be present. Operating electric controllers to start ventilation fans may ignite these gases. Desmoking with installed ventilation can proceed with minimal risk once specific conditions are met. These conditions include the following:

- The fire is extinguished and overhauled
- The AFFF bilge sprinkling has been operated
- The source of the fuel for the fire is secured
- The space has been allowed to cool
- All fuel has been washed to the bilges
- No damage has been sustained to the electrical distribution system

J-99. Desmoking should begin once the compartment has cooled sufficiently so there is no danger from reignition. Circuit breakers that have tripped should not be reset until qualified personnel can make a damage assessment. Examine the electrical distribution system, and if possible, reestablish power to the installed ventilation fans. If the fans are fully operational, run them on high speed for a minimum of 15 minutes to remove smoke and toxic gases. If the installed system is partially operational or inoperative, desmoking will take longer, but can be accomplished by using portable blowers, or by providing a positive ventilation from adjacent spaces. On ships without AFFF bilge sprinkling, the safest method of desmoking is to exhaust the compartment with portable fans, or to provide a positive ventilation pressure from adjacent compartments.

## **ATMOSPHERIC TESTING**

J-100. Atmospheric tests are always conducted after desmoking is complete. An oxygen analyzer is unreliable when its sensor is exposed to excess moisture or comes in contact with particulates found in a post-fire atmosphere.

J-101. When the space is clear of smoke, test the atmosphere for oxygen, combustible gases, and toxic gases. The level of oxygen must be between 19.5 and 22 percent. Combustible gases must be less than 10 percent of the lower explosive limit, and all toxic gases must be below their threshold limits before the space is certified safe for personnel without breathing devices. After a class BRAVO fire, the compartment should be tested for the following gases:

- Hydrocarbons.
- Carbon dioxide.
- Carbon monoxide.
- Hydrogen chloride.
- Hydrogen cyanide.

J-102. Shipboard personnel authorized to conduct these tests aboard ship are the gas free engineer and the gas free designated representative. Required tests shall be conducted near the center and at all four corners, on each level of the compartment. At least one satisfactory reading at each location must be obtained.

## **DEWATERING**

J-103. Dewater the compartment with the commanding officer's permission, and in accordance with operating procedures. Dewatering a class BRAVO pool fire will not commence until the space is completely overhauled, except in extreme conditions where ship stability is threatened. Dewatering will affect the vapor barrier on top of pooled flammable liquid. Extreme caution must be exercised to ensure the AFFF blanket is

maintained until completion of overhaul. Following overhaul, normal dewatering may be conducted or completed at the same time as desmoking or post-fire gas free testing.

## COMPARTMENT REMANNING

J-104. Once the space is certified safe, remanning can begin. A careful damage assessment is conducted, and once individual equipment or systems are verified operational and safe, then may be placed in service.

## REENTRY

J-105. Reentry to a machinery space that has been evacuated because of fire is the most critical part of the firefighting evolution and potentially the most dangerous. The primary function of the reentry team is to attack and extinguish the fire, ensure the source of oil is secured, and cool the space so ventilation may be started.

### GENERAL GUIDELINES FOR REENTRY

J-106. When the fixed firefighting system has been activated:

- If the evidence is that the fire is extinguished, do not attempt reentry for at least 15 minutes after the discharge.
- If conditions in the affected space indicate that the fire has not been extinguished and continues to grow after the fixed firefighting system has been discharged.
- Feel bulkheads for temperature near the desired access
- Monitor exhaust vent discharge for smoke
- If CO2 equipped vessel, ventilate space and test BEFORE entry attempt
- If FM-200 equipped vessel, test space using damage control hand pump with ampoulets.
- Monitor conditions through the engineering operating station windows or peephole in escape doors.
- After reentry to the space, fires shall be extinguished. Reopen when the fire is out, re-flash watch is set, and fire overhauled. Ensure all sources of fuel are secured and covered with AFFF. To conserve AFFF, saltwater hoses should be used to cool the space after the fire is out. It should be assumed that AFFF hose reels in the space have been damaged by the fire and they should not be relied on until it can be established that the system has not been damaged by fire.

J-107. When FM 200 is not installed:

- Electrical isolation, with the exception of lighting, shall be completed as specified in Emergency Operations Control Center immediate actions. Electrical isolation, although ongoing, should not delay space reentry.
- Reentry should be made through the access, main door, hatch, or escape trunk, whichever is not obstructed by the fire. The conditions in the affected space should be checked before entry by feeling bulkheads for temperature near the desired access, monitoring exhaust vent discharge for smoke, and monitoring operating conditions through the engineering operating station windows or peephole in escape trunk doors.
- Repeated efforts may be necessary to gain access to the space. The nozzleman uses the reentry hose wide-angle fog to cool metal surfaces and protect himself. It should be assumed that the hose reels in the space have been damaged by the fire and they should not be relied on for use until it can be established that the system has not been damaged by fire.
- Once inside the space; locate, extinguish, and report: fire out and set re-flash watch. Report that re-flash watch is set. Overhaul the fire. Secure and cover all flammable liquids with AFFF. Allow the space to cool. To conserve AFFF, saltwater hoses should be used to cool the space after the fire is out.

## **INVESTIGATION**

J-108. After overhaul, the fire should be investigated to determine the point of origin, types of combustibles involved, path of fire spread, ignition source, and significant events in the growth and eventual extinguishment of the fire. Starting from the point of farthest fire spread, burn patterns will usually extend back to the area of origin. Efforts should be directed toward recreating the conditions that caused the fire and identifying any changes in design or procedures that could have prevented the fire or lessened its spread and intensity. These changes are very helpful to ship designers and operators. Photographs, material samples, metallurgical samples, and failed equipment assist in reconstructing a fire history. If there is a major fire which involves significant damage or loss of life, a NAVSEA technical expertise team is available to investigate such fires, and to develop lessons learned from a ship design and a material standpoint.

## **HEAT STRESS**

J-109. Extreme compartment heat, weight of the FFE, carrying heavy equipment, and handling a fire hose are contributing factors to heat stress. As fire fighters rotate out of the compartment, the team leader and scene leader will coordinate relief personnel. Under harsh conditions, personnel working hard (such as the nozzleman) will need to leave the compartment sooner than others. A complete relief team should be standing by, ready to enter as needed, to relieve personnel in the space.

J-110. Heat stress training is conducted as part of “all hands” training, and you must be aware of its symptoms and required treatment. The symptoms of heat stress are as follows:

- The skin appears ashy gray; the skin is moist and clammy.
- The pupils of the eyes may be dilated (enlarged).
- Vital signs are normal; but the victim may have a weak pulse and rapid shallow breathing.
- Heavy sweating.

J-111. You may observe these symptoms in one of your shipmates after leaving the compartment. The treatment for heat stress is as follows:

- Loosen clothing; apply cool wet cloths.
- Move the victim to a cool or air-conditioned space, and fan the victim.
- Do not allow the victim to become chilled.
- If the victim is conscious, provide a solution of 1 teaspoon of salt dissolved in a quart of water.
- If vomiting occurs, do not give any more fluids.
- Transport the victim to sickbay (if manned) or the nearest battle dressing station for treatment.

## **HEAT STROKE**

J-112. The symptoms of heat stroke are as follows:

- High body temperature.
- No sweating—skin is hot and dry.
- Pupils of the eyes may become constricted.
- Strong rapid pulse.
- Possible unconsciousness.

J-113. During heatstroke, the body is no longer able to sweat, preventing removal of excess heat. If the internal temperature of the body rises above 105°, the brain, kidneys, and liver may all suffer permanent damage. In its earlier stages, the victim may have shown symptoms of heat exhaustion, as detailed above. The treatment of heat stroke may include:

- Immediately informing medical personnel, moving the victim to the coolest possible area, and removing clothing.
- • Reduce body temperature immediately by dousing the body with cold water or by applying cold, wet towels to the body.
- Ensure the victim has an open airway.

- Place victim on his or her back, head and shoulders slightly raised.
- If cold packs are available, place them under the arms, around the neck, at the ankles, and on the groin. This helps lower internal body temperature.
- Give the victim cool water to drink. Do not give any hot drinks or stimulants.

J-114. This chapter provided information pertaining to the tactics and strategies involved in firefighting. Although every fire is different, certain practices apply to all fires. While the information is located in this appendix, there is no substitute for actual hands-on training. As you become proficient you will train your shipmates in firefighting, as well as other aspects of damage control. A properly trained in-port fire party or attack team may make the difference between dealing with a small easily controlled fire, and one that threatens the entire vessel.

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## **Appendix K**

# **Portable Firefighting and Dewatering Equipment**

Portable fire extinguishers are used to extinguish small fires in compartments or in the galley. Additionally, dewatering equipment, which includes pumps and eductors, may have to be used when fighting fires along with other portable equipment, such as fans and blowers. The characteristics and operation of these types of equipment are presented in this appendix.

## **PORTABLE FIRE EXTINGUISHERS**

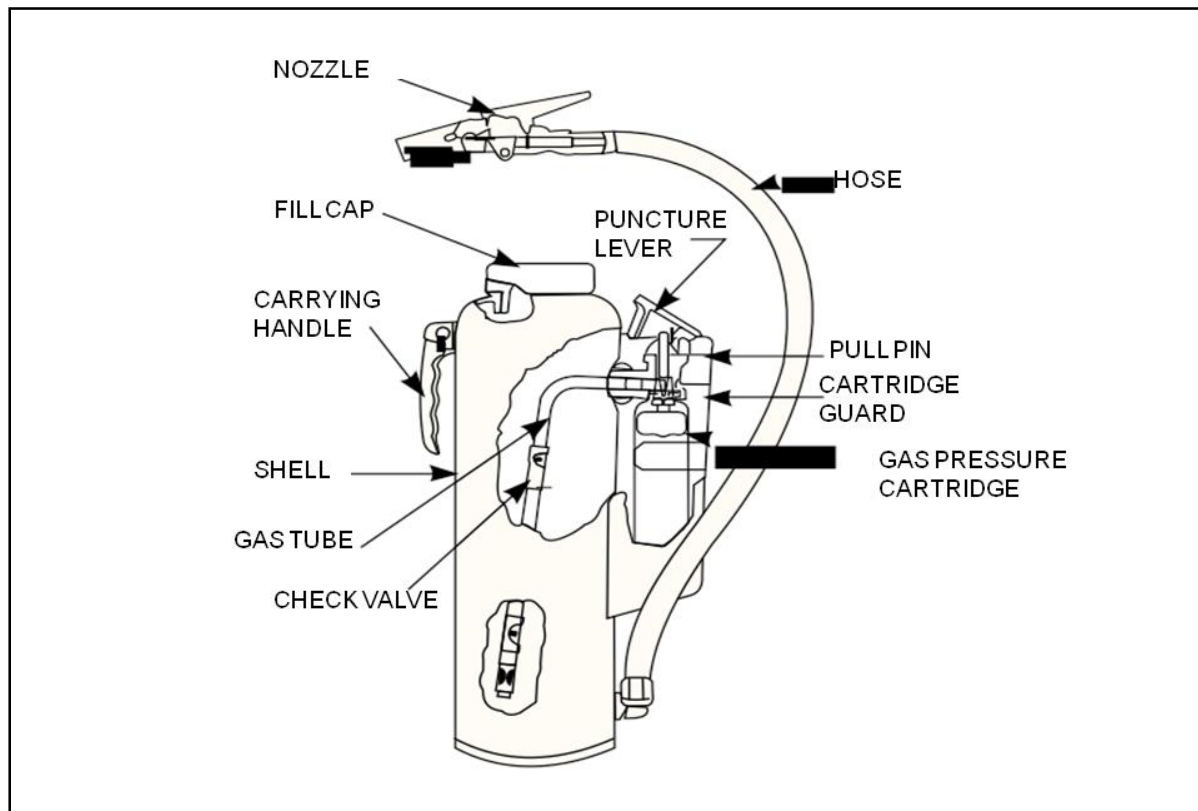
K-1. Portable fire extinguishers are used aboard all Army vessels and the three types most often used are:

- Dry chemical.
- Carbon dioxide (CO<sub>2</sub>).
- Aqueous film-forming foam (AFFF).

### **DRY CHEMICAL EXTINGUISHER**

K-2. Portable dry chemical extinguishers (figure K-1 on page K-2) are used primarily on class BRAVO fires. Purple-K-Powder (PKP) is the chemical most often used in these extinguishers. The dry chemical dispensed from the extinguisher interrupts the chemical reaction producing a fire and this action stops combustion.

K-3. Dry chemical is also safe and effective for use on class CHARLIE fires; however, carbon dioxide is preferred because PKP fouls electrical and electronic components. Also, PKP should not be used on internal fires of gas turbines or jet engines unless absolutely necessary because it also fouls engines. PKP is not effective on class ALPHA fires and can only be used to knock down flames and keep the fire under control until an appropriate extinguisher can be used.



**Figure K-1. Portable dry chemical extinguisher**

K-4. PKP extinguishers come in an 18-pound and a 27-pound size. Most PKP extinguishers have a small CO<sub>2</sub> cartridge mounted on the outside of the extinguisher shell. This cartridge provides the propellant charge for the extinguisher. Do NOT pressurize the PKP extinguisher until you are ready to use it.

K-5. The steps of the procedure you should adhere to when operating a dry chemical extinguisher are as follows:

- Step 1. Carry the extinguisher to the scene of the fire.
- Step 2. Remove the seal and pull the locking pin from the puncture lever marked PUSH.
- Step 3. Push the puncture lever down to penetrate the seal of the CO<sub>2</sub> cartridge. The extinguisher is now ready to use.
- Step 4. Approach the fire from the windward side, if possible. Hold the extinguisher in one hand and the nozzle in the other hand.
- Step 5. Discharge the dry chemical by squeezing the squeeze grip on the nozzle. Hold the nozzle firmly and direct the dry chemical at the base of the fire. Use a wide-sweeping motion from side to side. This will apply a dense, wide cloud of dry chemical over the area. Remember that the 27-pound extinguisher has a 21-foot range and the 18-pound extinguisher has a reach of 19 feet.
- Step 6. Be certain that all of the fire in the area in which you are working is extinguished before you move in farther. If the fire appears to be too large or if there is a possibility of being outflanked or surrounded by flames, attack the fire with the assistance of two or more personnel using extinguishers.
- Step 7. Do not try to economize on the dry chemical. Use as much as necessary (and as many extinguishers as necessary) to extinguish the fire completely.
- Step 8. Always back up dry chemical with water or foam.
- Step 9. After a dry chemical extinguisher has been used, invert the cylinder, squeeze the discharge lever of the nozzle, and tap the nozzle on the deck. This will release any pressure left in the cylinder.

and cartridge and any dry chemical left in the hose and nozzle. By inverting the cylinder, you prevent further discharge of dry chemical and conserve the powder. Make sure that dry chemical does not remain in the hose and nozzle; it will cake up and clog them.

K-6. The steps of the procedure you should adhere to when recharging a dry chemical extinguisher are as follows:

- Step 1. Invert the extinguisher and tap the side of the cylinder with the nozzle to knock down any loose dry chemical. Then bleed off the pressure.
- Step 2. Remove the fill cap.

### **WARNING**

**Do NOT lean over the top of the extinguisher when you remove the fill cap. If dry chemical splashes on you, it could cause severe injury to your skin and eyes.**

- Step 3. Fill the cylinder with dry chemical only to the bend in the tube. The extra space allows the powder to be aerated when the cylinder is pressurized. This ensures that the powder will not be caked when it is applied.
- Step 4. Remove any dry chemical from the internal threads of the bottle and from the threads of the cap.
- Step 5. Replace the fill cap.

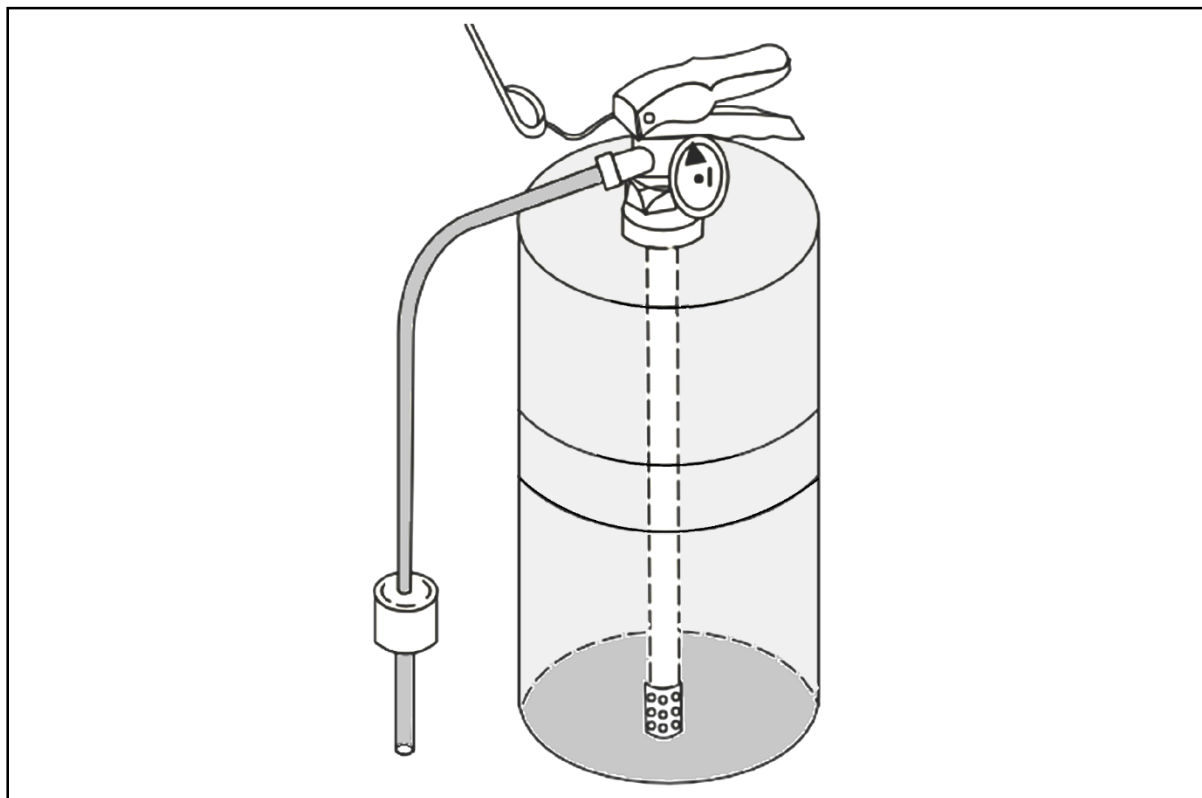
K-7. The steps of the procedure you should adhere to when installing a new CO<sub>2</sub> cartridge are as follows:

- Step 1. Lift the lever cutter assembly and insert the locking pin.
- Step 2. Reseal the locking pin and cutter lever.
- Step 3. Remove the guard covering the CO<sub>2</sub> cartridge.
- Step 4. Unscrew the expended CO<sub>2</sub> cartridge.
- Step 5. Remove the cap and gasket from a new CO<sub>2</sub> cartridge.
- Step 6. Thread the new cartridge, which has left-hand threads, into the fitting of the cutter assembly.
- Step 7. Replace the CO<sub>2</sub> cartridge guard.

## **AQUEOUS FILM-FORMING FOAM FIRE EXTINGUISHER**

K-8. Portable aqueous film-forming foam (AFFF) fire extinguishers are used to provide a vapor seal over a small fuel spill, extinguish small class BRAVO fires (such as deep fat fryers), and for standing fire watch during hot work.

K-9. The portable AFFF fire extinguisher (see figure K-2 on page K-4) is a stainless steel cylinder containing 2 1/2 gallons of premixed AFFF concentrate and water. It is pressurized with air to 100 psi at 70° and weighs approximately 28 pounds when fully charged. The mixture will expand about 6.5 to 1 and will produce about 16 gallons of foam. The AFFF extinguisher has a 55-65 second continuous discharge time and an initial range of 15 feet, which decreases during discharge.



**Figure K-2. Portable aqueous film forming foam (AFFF) fire extinguisher**

K-10. Some important facts you should remember about the operation and use of an AFFF extinguisher are:

- The AFFF extinguisher is designed for use on class BRAVO pool fires; however, it may also be used on class ALPHA fires. AFFF is NOT recommended for use on class CHARLIE fires (energized electrical components).
- Before attacking a fire, ensure the pressure within the cylinder is within the proper range, and remove the locking pin. To operate, squeeze the operating lever above the carrying handle. The extinguisher is capable of continuous operation or multiple bursts.
- AFFF extinguishes class ALPHA fires by cooling. It is superior to water because AFFF has added wetting and penetrating ability. For small class ALPHA fires, apply AFFF to the base (source) of the fire.
- AFFF extinguishes a class BRAVO fire or protects an unignited fuel spill by floating on the flammable liquid and forming a vapor seal. One AFFF extinguisher will effectively extinguish 20 square feet (4 1/2 feet by 4 1/2 feet) of flammable liquid fire. To apply, start from 15 feet away and sweep the AFFF from side to side at the base of the fire. One AFFF extinguisher can be used to vapor seal a fuel spill to prevent a fire up to 40 square feet (about 6 feet by 6 feet) in size. Larger fuel spills, or spills which are not fully accessible or visible, should be covered using 1 1/2-inch AFFF hose or by the installed bilge sprinkling system.
- Deep fat fryer fires often require special procedures to extinguish them. Combinations of AFFF and PKP may be needed to put out these fires and prevent their spread throughout the space or into ventilation ducting. AFFF should only be directed at the back wall of the fryer, allowing the stream to flow onto the surface of the burning oil. This technique does not disrupt the cooking oil and allows the fire to be put out and a layer of foam to be developed over the oil.

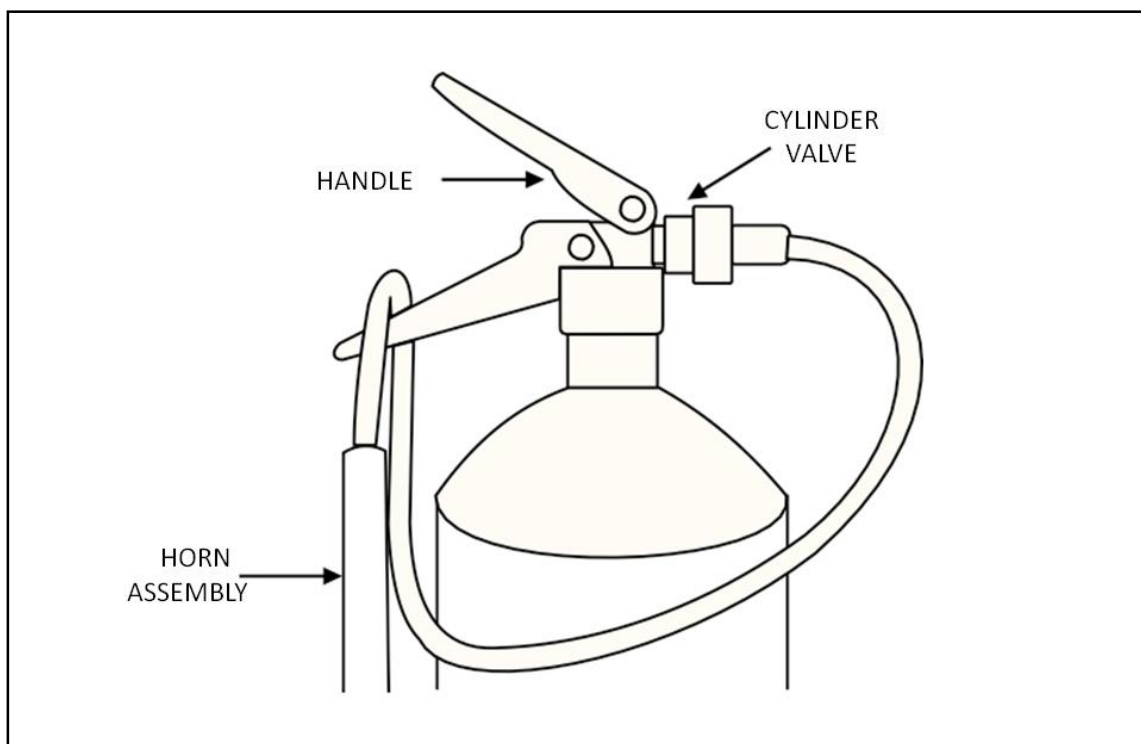
**WARNING**

**Do not direct AFFF directly into hot cooking oil because doing so can result in immediate boiling of the AFFF. This violent boiling may result in hot cooking oil splashing out of the fryer onto fire fighters.**

**CARBON DIOXIDE FIRE EXTINGUISHER**

K-11. The standard CO<sub>2</sub> fire extinguisher (shown in figure K-3) has a rated capacity (by weight) of 15 pounds of CO<sub>2</sub>. Removing the locking pin and squeezing the release valve built into cylinder valve operates it. CO<sub>2</sub> extinguishers are primarily used on small electrical fires (class CHARLIE) and have limited effectiveness on class BRAVO fires.

K-12. Carbon Dioxide extinguishers generate static electricity with the friction created as the high pressure liquid agent quickly passes up the siphon tube, through the valve, and out the discharge hose assembly where it is released as a cold gas or snow. Because the rubber hose and insulated nozzle horn are non-conductive material surfaces able to accumulate the buildup of static electricity, these extinguisher components incorporate conductive wires or similar materials to help dissipate most of the static that is generated. The National Fire Protection Association (NFPA)-10, *Standard for Portable Fire Extinguishers* has specific references addressing these issues. Extinguisher service recommendations require annual continuity testing and labeling of these extinguisher components to ensure they remain capable of dissipating static buildup. When these components are damaged, the fire extinguisher operator carrying and supporting the extinguisher during discharge may experience a static shock, if the static buildup instead grounds itself through the hand and body of the operator. Setting the fire extinguisher cylinder directly onto the ground during discharge can help reduce or eliminate the buildup of static electricity



**Figure K-3. 15-pound carbon dioxide fire extinguisher**

K-13. The steps for operating the CO<sub>2</sub> extinguisher are as follows:

- Carry the extinguisher in an upright position and get as close to the fire as possible.
- Place the extinguisher on the deck and remove the locking pin from the valve.
- Grasp the insulated handle of the horn. Rapidly expanding CO<sub>2</sub> causes the horn to become quite cold.
- Squeeze the operating lever to open the valve and release CO<sub>2</sub>. Direct the CO<sub>2</sub> toward the base of the fire. The maximum range of a 15-pound CO<sub>2</sub> extinguisher is 4 to 6 feet from the outer end of the horn. In continuous operation, the 15-pound CO<sub>2</sub> extinguisher will be expended in approximately 40 seconds.

### **WARNING**

**Shock from static electricity can be avoided if you ground the cylinder to the deck when discharging CO<sub>2</sub>.**

## **DEWATERING EQUIPMENT**

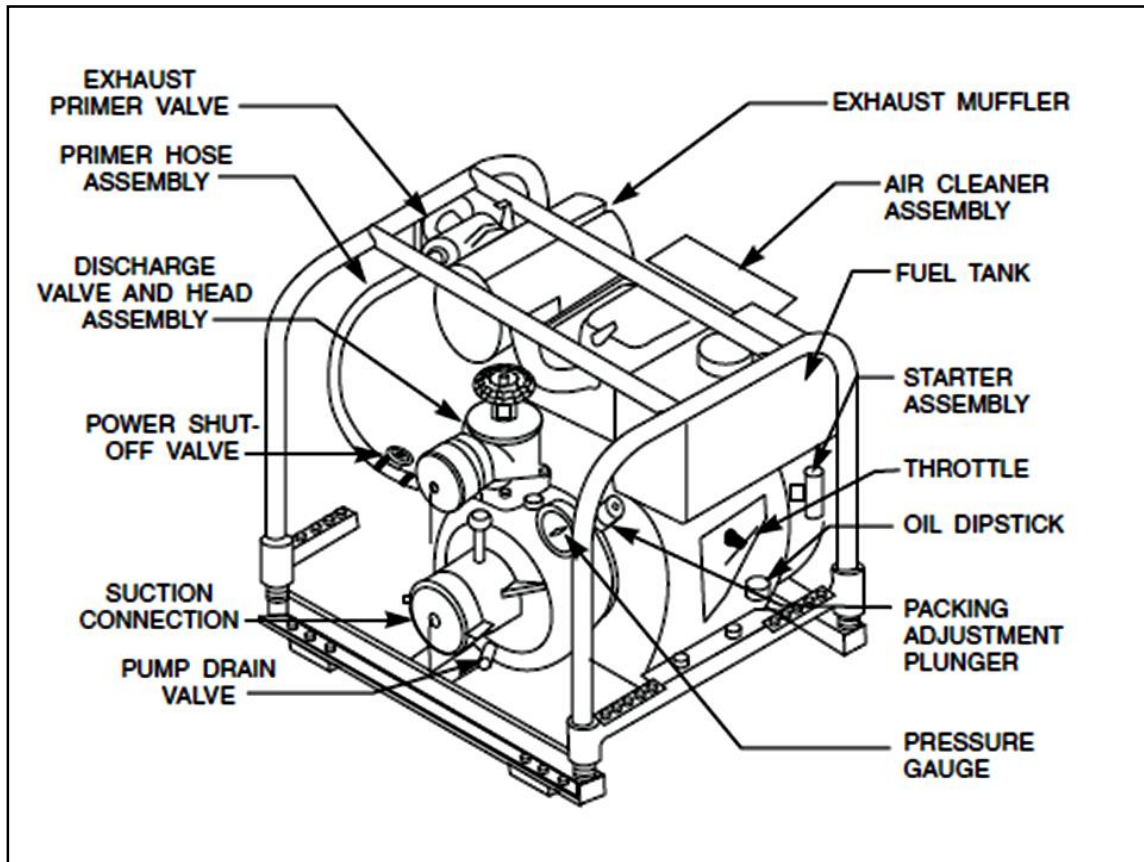
K-14. This section details the dewatering equipment, setup, and configuration that are most frequently used aboard Army watercraft.

### **P-100 PUMP UNIT**

K-15. The P-100 pump unit is commercial diesel driven portable pump designed for firefighting, dewatering, and many utility functions. The design features of the pump unit are described in the following paragraphs. The pump unit consists of the engine, centrifugal pump, exhaust primer, discharge valve, recoil starter, attached 1.45 gallon fuel tank, and compound pressure gage (see figure K-4 on page K-7). The pump unit measures 21"W X 23.5"L X 24.38"H. The wet weight of the pump unit is 164 pounds which includes 1.45 gallons of fuel that will allow 2.75 hours of operation. The pump is designed to provide 100 gallons per minute at 83 PSI while lifting 20 feet. In high lift operations, the pump unit will deliver 68 gallons per minute at 45 PSI while lifting 39 feet.

### **WARNING**

**The diesel engine exhaust contains poisonous carbon monoxide. Never use the pump unit in poorly ventilated locations, such as enclosed spaces. If such operation is unavoidable, provide proper ventilation and use an approved exhaust hose routed to the weather decks.**



**Figure K-4. P-100 Pump**

K-16. Two examples of fire-fighting hookups are shown in figure K-5 and K-6 on page K-8. A dewatering configuration is shown in figure K-7 on page K-9.

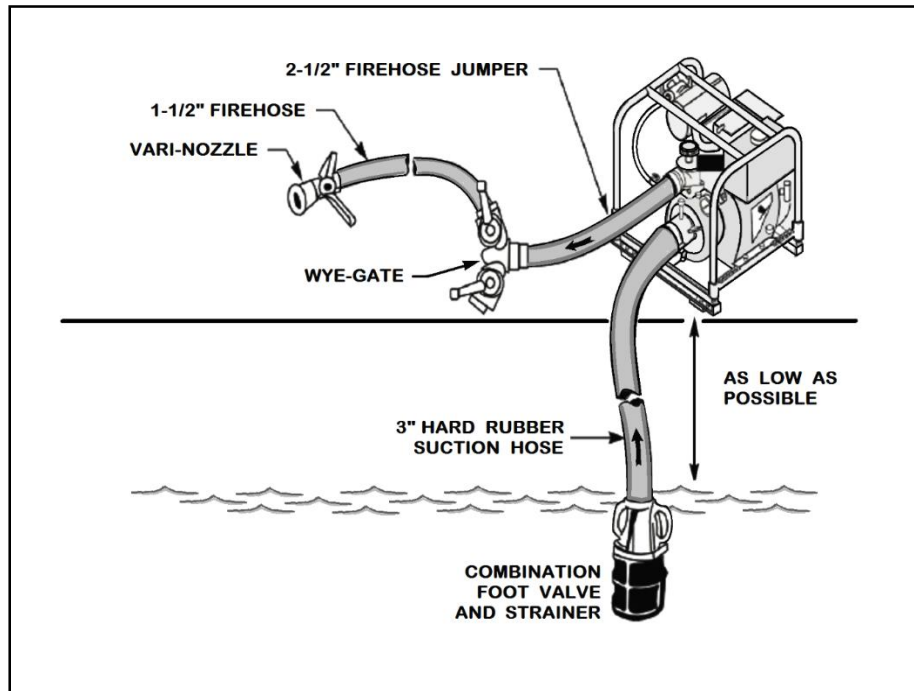


Figure K-5. Typical firefighting hook up

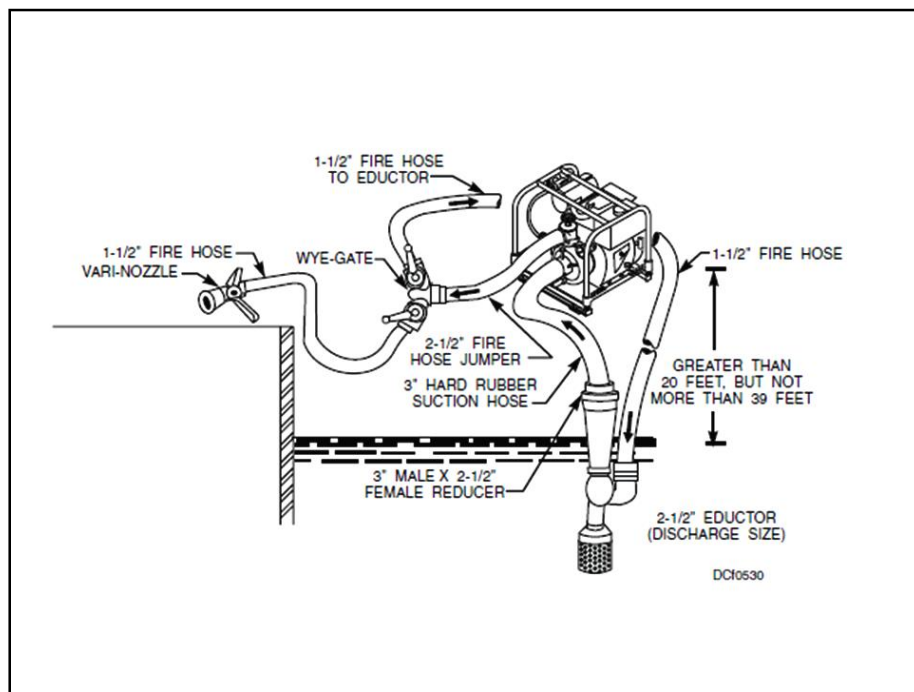
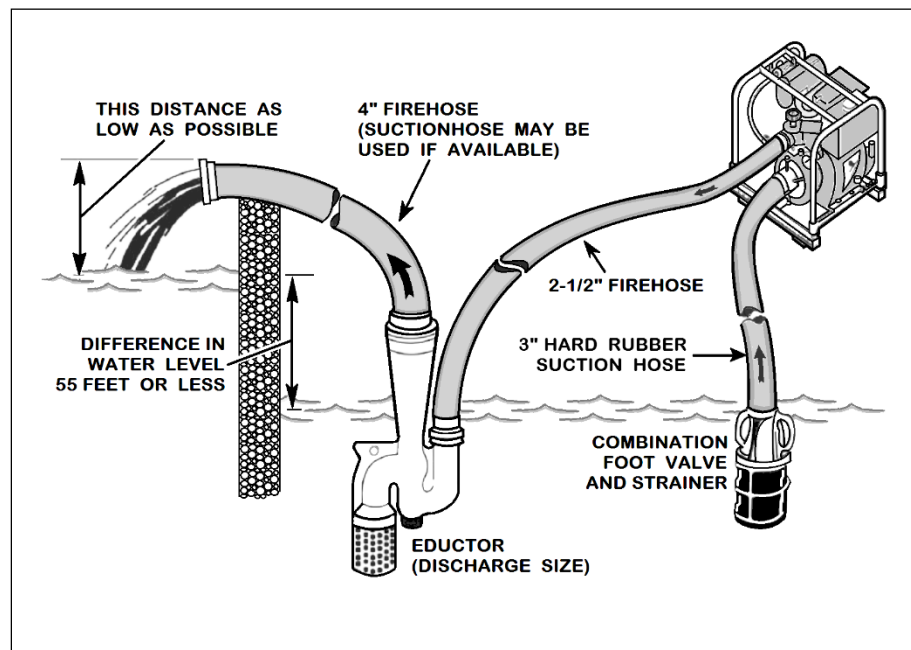


Figure K-6. Firefighting hook up for suction lifts greater than 20 feet





**Figure K-7. Typical P-100 dewatering configuration**

K-17. Various types of maintenance will be required to maintain the P-100 pump in operating condition, such as cleaning, inspection, lubrication, and testing. Maintenance will be accomplished according to PMS. Repairs may also be necessary and should only be accomplished by trained personnel, using approved procedures from the manufacturer's technical manual.

K-18. The P-100 pump should be stowed on the damage control deck or above. No more than one single pump will be stored within a single main watertight division. One pump, complete with all accessories, will be stowed for ready transfer off the ship for rescue and assistance use. The P-100 pump has a total dry weight of 106.9 pounds; therefore, one person should not attempt to move it alone.

## Engine

**Note.** YANMAR ENGINE MODEL L100AE-D WAS SUPPLIED PRIOR TO JANUARY 2000. YANMAR ENGINE MODEL L100EE-D IS SUPPLIED AFTER JANUARY 2000.

K-19. The Yanmar L100AE and L100EE engines are air cooled, single cylinder, four cycle diesel engine rated at 10 horsepower. Ignition is achieved by direct injection of fuel and compression is initially aided by a compression release lever to help overcome the 19.3 compression ratio. The engine is started by a recoil type starter. The engine's single cylinder has a displacement of 0.406 liters (24.78 cubic inches) which corresponds to the stroke X bore of 1-86 X 70 mm (3.386 X 2.756 in.).

K-20. The fuel injection pump is a Bosch type Yanmar PFE-M type, timed at 13 plus or minus 1 b TDC. It supplies a Yanmar YDLLA-P type fuel injection nozzle which delivers fuel at an injection pressure of 19.6 Megapascal (200 kilogram-force/square cm). The fuel oil filter is a paper element type built into the 5.5 liter (1.45 gallons) attached fuel tank.

K-21. The engine utilizes forced lubrication via trochoid pump and splash lubrication for valve rocker arm chamber. The lubricating oil filter is a resin, 60 mesh type. The engine lubricating oil capacity is 1.65 liters (0.44 gallons). The recommended oil for commercial use is SAE 10W30, API grade CC or higher for ambient temperatures less than 85 degrees F. The oil specified is MIL-L-2104, equivalent to SAE 15W40. The air cleaner element is a dry paper element type. The engine is cooled by forced air generated by a flywheel fan. Speed control is accomplished by an all speed type mechanical governor.

K-22. The engine dimensions, length, width, height, are 417 X 470 X 494 mm (16.417 X 18.504 x 19.449 inches). The dry weight of the engine is 48.5 kg (106.9 lbs.).

## Pump

K-23. The Darley 2BE pump is a single suction, single stage centrifugal pump complete with a compound pressure gage, drain valve, and primer connection. The impeller is a closed design and the shaft is sealed by a unique palletized packing gland. The shaft seal utilizes injection palletized packing with a stuffing box. The suction and discharge connections have male threads which receive 3 inch and 2-1/2 inch hoses, respectively.

K-24. The pump casing is fabricated from a hard coat anodized aluminum alloy which is light weight and corrosion resistant. The impeller is dynamically balanced and is of a bronze alloy construction. The wearing rings are a bronze labyrinth type.

## Exhaust Primer

K-25. The engine exhaust silencer is constructed to incorporate a jet type ejector and receive an insulated exhaust hose. When the primer is operated, the main exhaust port is blocked by the cylinder valve forcing the exhaust flow through the priming jet. The vacuum developed by the exhaust jet evacuates the air from the pump casing and suction hose. Because of the vacuum developed, atmospheric pressure forces water up through the suction hose and into the pump casing.

K-26. The exhaust hose is a dry 4.5" insulated hose which is available in 10' sections. The hose weighs only 1.7 pounds per linear foot and provides adequate protection for safe handling with firefighter's gloves during and after operation. The function of the exhaust hose is to safely route harmful exhaust gases to weather when indoor operation becomes necessary.

## Fuel Tank

K-27. The 1.45 gallon capacity fuel tank is mounted to the engine. The tank consists of the tank, fuel filter, isolation valve, injection valve, level sight tube, and a fuel tank cap.

## Preparation For Priming

K-28. Check coupling gaskets and connect hose lines with couplings properly tightened.

K-29. A strainer with openings not larger than 1/4" mesh must always be used on the end of suction line when pumping water from draft.

### CAUTION

THE SUCTION HOSE MAY REQUIRE SUPPORT TO PREVENT EXCESSIVE WEIGHT FROM STRESSING THE PUMP CASING, INBOARD HEAD, OR ENGINE. WHERE PRACTICAL, THE SUCTION HOSE SHOULD BE TIED TO SOME NEARBY STRUCTURE AND/OR BLOCKS SHOULD BE PLACED BENEATH THE SUCTION HOSE ADJACENT TO THE UNIT TO RELIEVE STRESS ON THE PUMP.

K-30. Avoid air traps in suction hose if possible.

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**Note.** BE CERTAIN THAT THE SUCTION HOSE (OR PIPE) IS ABSOLUTELY AIR TIGHT. NEITHER THE PUMP NOR THE PRIMER WILL LIFT WATER IF THE SUCTION SIDE OF THE PUMP HAS THE SLIGHTEST AIR LEAK.

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K-31. Keep the suction intake strainer well above the bottom of the water source to prevent picking up soil and other foreign matter. If the strainer must lie on the bottom, a metal plate or pan should be laid under it.

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**Note.** WATER MAY BE DRAFTED FROM PONDS, LAKES, STREAMS, CISTERNS, TANKS, SEA WATER, AND/OR WELLS. WHATEVER THE SOURCE, THE STATIC LIFT MUST NOT EXCEED 22 FEET FROM THE CENTER OF THE PUMP TO THE SURFACE OF THE WATER. A LIFT NOT EXCEEDING 10 FEET IS RECOMMENDED. THE SOURCE OF SUPPLY SHOULD BE REASONABLY CLEAR AND FREE FROM FOREIGN MATTER.

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K-32. Submerge the suction intake sufficiently into the water to prevent sucking in air. A cover laid over the top of the strainer will allow the pump to operate with a minimum of submergence.

K-33. Close drain valve and all other openings into pump casing.

K-34. Do not start the engine until everything is ready for pumping, with hose couplings properly tightened. Pump discharge check valve may be partly open during priming at lifts less than 10 feet, and completely closed for lifts of 10 feet and more.

### **Shutdown**

K-35. To stop the pump unit, reduce engine speed to an idle speed and allow the engine to cool down for two minutes. Return the engine throttle control to the “STOP” position. If engine continues to run, shut the fuel tank isolation valve.

K-36. After operating the P-100 Pump, if the pump has been used to pump seawater, the seawater must be drained from the pump by opening the pump casing drain valve. The pump must be flushed with fresh water for three to five minutes to prevent corrosion and salt crystals from forming on close tolerance pump internals. After flushing the pump, apply a spray silicone compound to pump internals while slowly pulling the starter rope and replace hose connection caps.

K-37. Drain water out of pump casing immediately. The drain valve is located at the lowest point in the pump casing. Do not forget to close all drain cocks after draining all the water. If forgotten, trouble in priming will follow on the next run. Check lubrication after every run.

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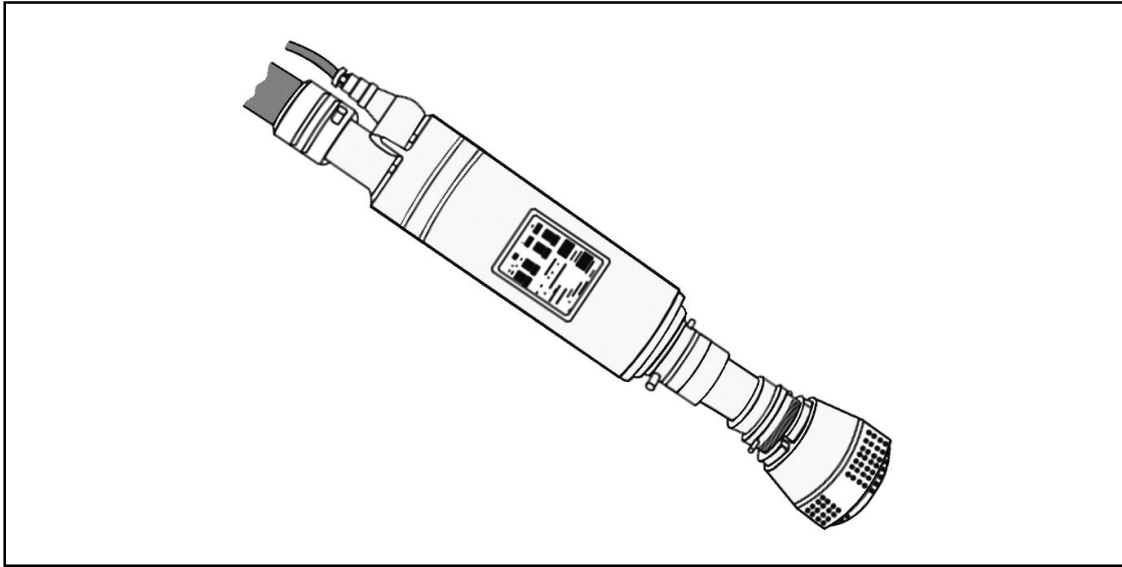
**Note.** Periodically inspect and run pumps used for fire service to ensure that they will be ready in an emergency.

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K-38. See NAVSEA S6226\_NM-MMC-010/15852, Revision 1 for additional information on operating, maintenance, and troubleshooting of the P-100 Pump.

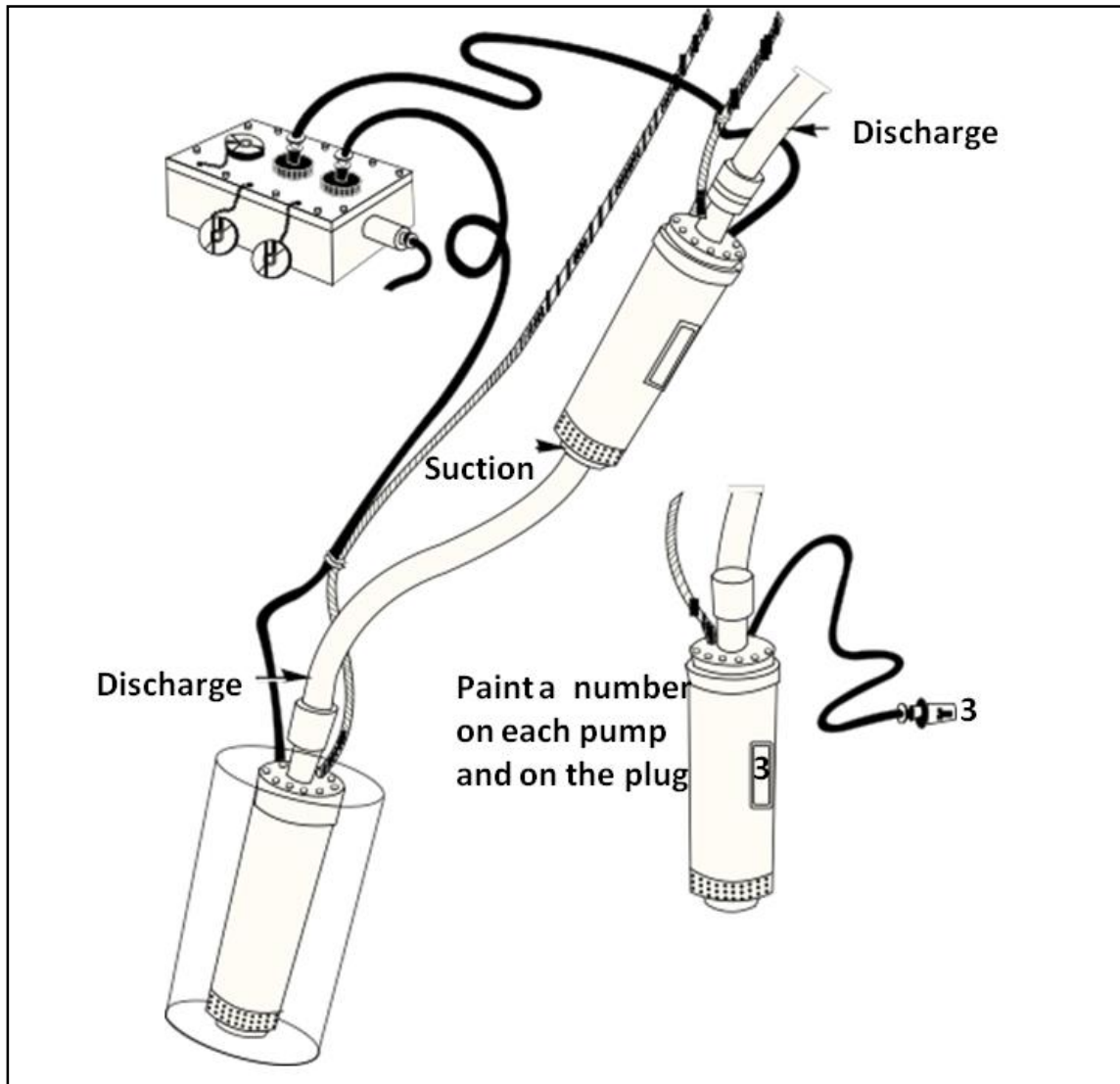
### **PORTABLE SUBMERSIBLE PUMPS**

K-39. The portable submersible pump (see figure K-8 on page K-12) used aboard ships is a centrifugal pump driven by a water-jacketed constant speed alternating current electric motor and may be designed to operate as single or three phase at 120, 240, or 440 volts. This design is rated to deliver 140 gallons per minute against a maximum head of 70 feet and 180 gallons per minute at a 50 foot static head. This output is variable and will increase with a decrease in head pressure. Strainers are always used with submersible pumps when floodwater is being pumped. Some pumps of this type are mounted semi permanently with the discharge connected to a drainage system.



**Figure K-8. Alternating current portable electric submersible pump**

K-40. To dewater a compartment with a submersible pump, lower the pump into the water using the attached nylon handling line and lead the 2 1/2-inch discharge hose to the nearest point of discharge. This may be an emergency overboard discharge connection, found on the damage control deck. The amount of water taken from a flooded space increases as the discharge head decreases. Therefore, dewatering is accomplished most efficiently if the water is discharged at the lowest practicable point and if the discharge hose is short and free from bends and kinks. When it is necessary to dewater against a high discharge head, you can use two submersible pumps in tandem (series), as shown in figure K-9 on page K-13. The pump at the lower level lifts water to the suction side of the pump at the higher level. A multiple outlet connection box is used to make the necessary electrical connections and will allow concentration of multiple pumps in a single location.



**Figure K-9. Electric pumps in tandem**

### Portable And Fixed Eductors

K-41. Eductors (figure K-10 on page K-14) are jet-type pumps that contain no moving parts. An eductor contains jets (sometimes called nozzles), as shown in figure K-11 on page K-15, through which water flows under pressure. The firemain (or the P-100 fire-fighting pump) supplies the actuation water that enters the eductor through the supply connection. The velocity (speed) of the water increases while flowing through these nozzles and creates a vacuum in the suction area of the eductor. The suction side of the eductor is connected to a non-collapsible hose or may be submerged into a flooded space to remove the water.

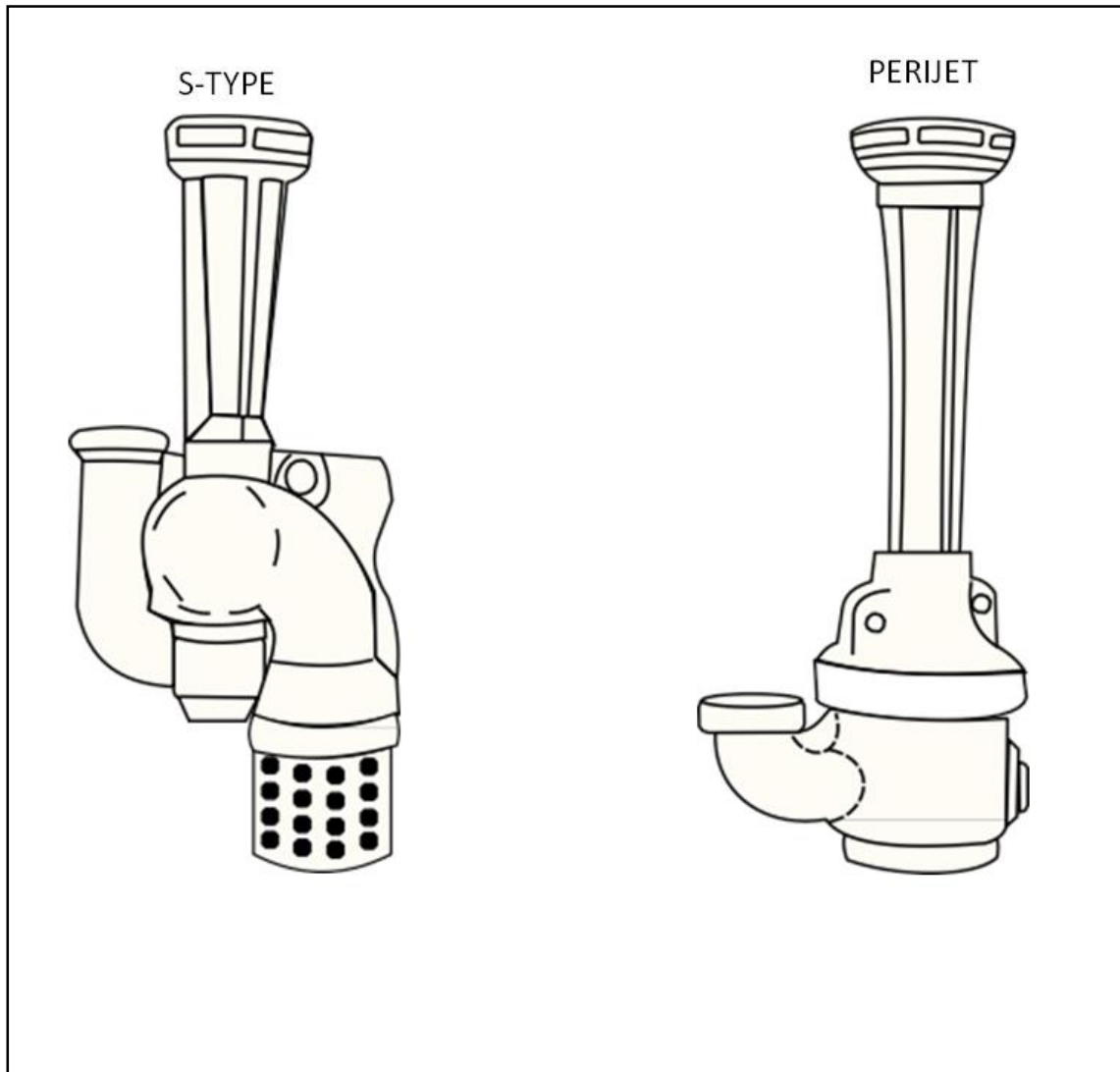
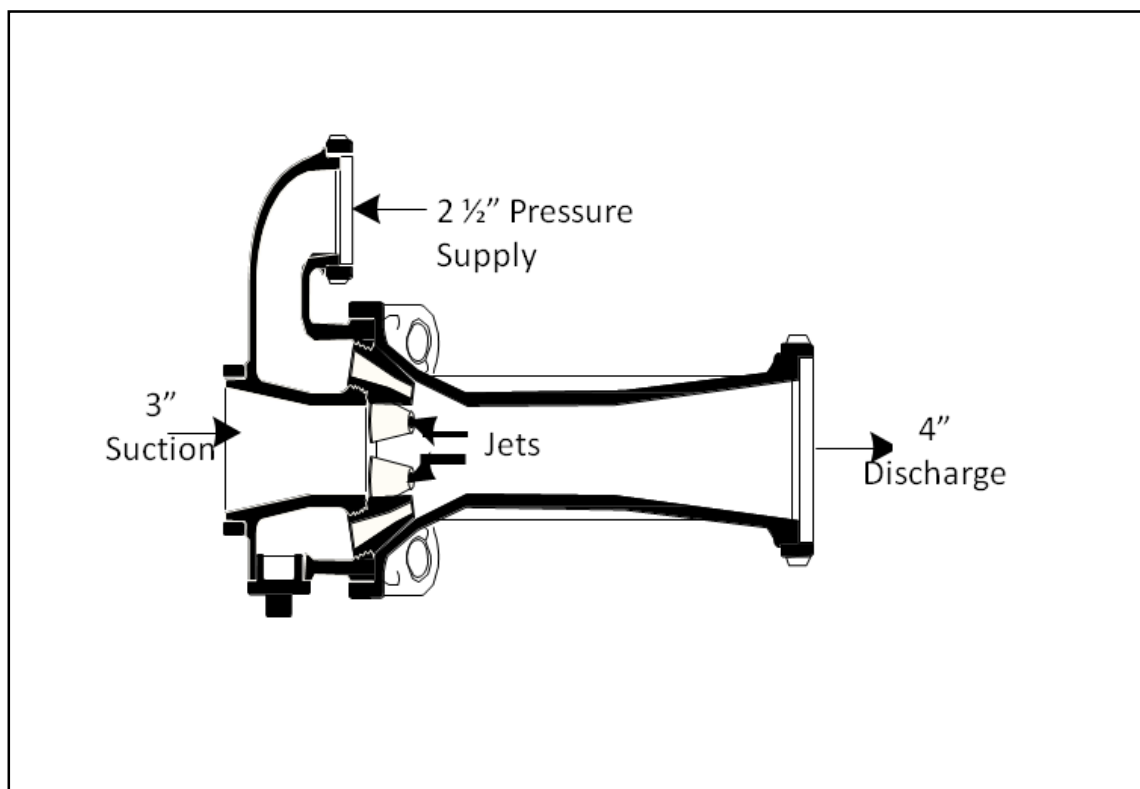


Figure K-10. Portable Eductors



**Figure K-11. Cross section of peri-jet eductor**

K-42. Eductors are used to pump liquids that cannot be pumped by other portable pumps (such as heavy oils and flammable liquids) and are able to remove liquids that contain small particles of foreign matter. The rate of dewatering will depend on actuation pressure (from the firemain) and the discharge head (how far above the eductor the water has to rise to be removed). When observing the eductor operation, you must be aware that not all of the eductor discharge is supplied from the compartment being dewatered. A large percentage of this discharge is the actuation water supplied by the firemain

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**Note.** Oils and flammable liquids are not normally permitted to be discharged overboard and should be disposed of according to environmental regulations.

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K-43. There are other factors, which may affect eductor operation. The condition of the suction piping must be inspected periodically for deterioration, and all joints and flanges should be tight. Air entering the suction piping will prevent the eductor from operating properly. Drainage valve misalignment in other spaces will affect eductor operation as well. You may unknowingly be removing water from the bilges in an adjacent space instead of the intended compartment. Proper supply pressure from the firemain must be substantially higher than the pressure against which the eductor is required to operate. If the pressure is not high enough to be discharged overboard, it will simply back up through the eductor into the space, actually increasing the rate of flooding in the compartment. Improper valve lineups may actually cause flooding in other compartments. When using the eductor, posted operating procedures, or Engineering Operational Sequence System (if installed), is mandatory.

K-44. Installed eductors function to create a vacuum in suction piping, removing water from bilges, either in the compartment where they are located or remotely. Unattended operation, especially in remote spaces, may asphyxiate personnel working in the compartment. Train personnel working in confined or closed spaces to recognize the potential for hazards of asphyxiation.

### **WARNING**

**Eductors located in remote spaces, if activated, can remove all breathing air, particularly if ventilation is secured, inadequate, or not installed. Ensure sufficient make-up air is provided and the space has adequate oxygen before entry in all eductor-equipped remote spaces. Maintain communication with personnel working inside the remote space while eductor operation is in progress.**

K-45. Concern for the environment is extremely important, and various pollution laws have been enacted. Federal law prohibits the discharge of oil into inland or coastal waters, and there are restrictions pertaining to shipboard discharges on the high seas. The engineering officer of the watch must give permission for eductor operation.

K-46. Fixed eductors are installed in the ship's main drainage system and are normally used to dewater bilges. Fixed eductors are normally of the peri-jet design with no suction strainers installed. A cross-sectional view of a peri-jet eductor is shown in figure K-11 on page K-15.

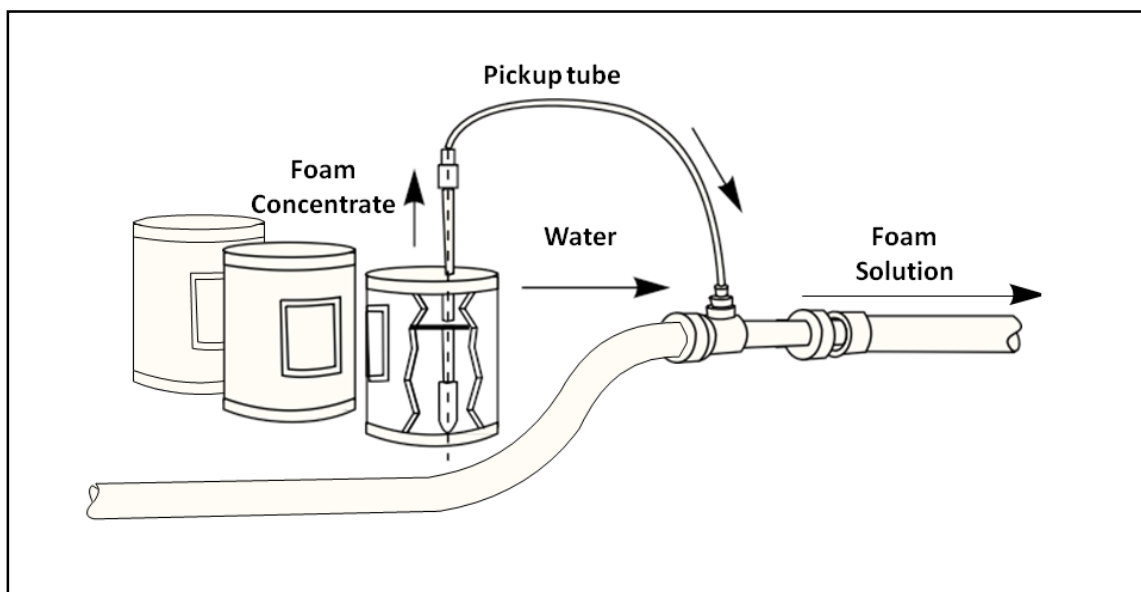
K-47. Portable eductors can be rigged as required to dewater a compartment or space. They are often used with the P-100 pump to dewater compartments. Figure K-7 on page K-9 shows one arrangement that could be used. In this arrangement both the P-100 pump and the eductor are removing water from the flooded compartment.

#### **Portable AFFF In-Line Eductors**

K-48. The portable in-line eductor is used to mix seawater and AFFF concentrate to produce an AFFF solution for combating fires especially class BRAVO fires. The eductor consists of a bronze body with an internal ball check valve and flexible pickup tube assembly. The eductor is used in conjunction with a 95 gallons per minute vari-nozzle. Seawater passing through the eductor creates suction in the pickup tube assembly which, in turn, draws AFFF concentrate from a 5-gallon can or 55-gallon drum (figure K-12 on page K-17). The eductor mixes the AFFF concentrate and seawater at approximately 6 percent ratio when the inlet pressure to the eductor is 100 pounds per square inch gauge. Continuous use will require about 5 gallons of AFFF concentrate per minute.

K-49. In-line eductors should be connected directly to fire plugs to minimize inlet pressure reduction due to friction loss. Friction loss downstream of the eductor can create sufficient backpressure so the AFFF suction will cease to operate, but seawater will continue to flow. Users of the in-line eductor must limit the hose length downstream of the eductor to three lengths (150 feet) when fighting fires in the horizontal plane or advancing up not more than one deck. When the AFFF eductor is rigged on a deck above the deck where the fire is being fought (as in machinery space re-entry), up to six lengths of hose (300 feet) may be connected downstream of the eductor.





**Figure K-12. Aqueous film forming foam (AFFF) in-line eductor setup**

K-50. The emergencies overboard discharges connections, port and starboard, are installed through the hull of each main transverse subdivision on the damage control deck. It is a 4-inch connection, reduced to 2 1/2 inches, and is normally used during dewatering evolutions. Some smaller ships may use a standard 2 1/2-inch connection that does not require a reducer. These connections are not normally fitted with valves; instead, they are fitted with watertight screw caps over the inboard ends. Eductor or portable fire-fighting pumps may be directed overboard through these connections.

K-51. Maintenance for the emergency overboard discharge connections will include cleaning, inspecting, and lubrication. Maintenance will be accomplished according to the applicable planned maintenance.

## PORTABLE FANS AND BLOWERS

K-52. Different types of fans and blowers are available for desmoking, and each has different advantages. Some are electric motor-driven and are not to be used in explosive environments. Other blowers are powered by the firemain; these require that the firemain be available and that hoses be rigged to supply them. These fans require cleaning, inspection, and maintenance to ensure their reliability, and this may be your responsibility. Additionally, you may be involved in repairs and/or component replacement and will use PMS and the manufacturer's technical manuals to ensure quality maintenance.

K-53. Fans or blowers are often used to recirculate or remove large volumes of air. Electric "box" fans are convenient and easy to rig but pose risks when operating in (or removing) explosive atmospheres. Additionally, these fans require that power be available for operation. Water-driven blowers do not pose this threat (as long as they are properly grounded), but other considerations do apply. The firemain is the motive force for this blower and must be rigged to supply it, as well as a discharge hose.

### Portable Water Driven Fan

K-54. The portable water driven fan (figure K-13 on page K-18) is one of the primary fans used aboard ships for desmoking or introducing ventilation into a compartment. The firemain or a P-100 pump supplies the power for the fan through a 1 1/2-inch hose connection. A water turbine operates the fan blades, which may rotate in excess of 10,000 rpm (depending on firemain pressure). The fan is compact (18 inches in diameter) and weighs less than 35 pounds, allowing easy transport.

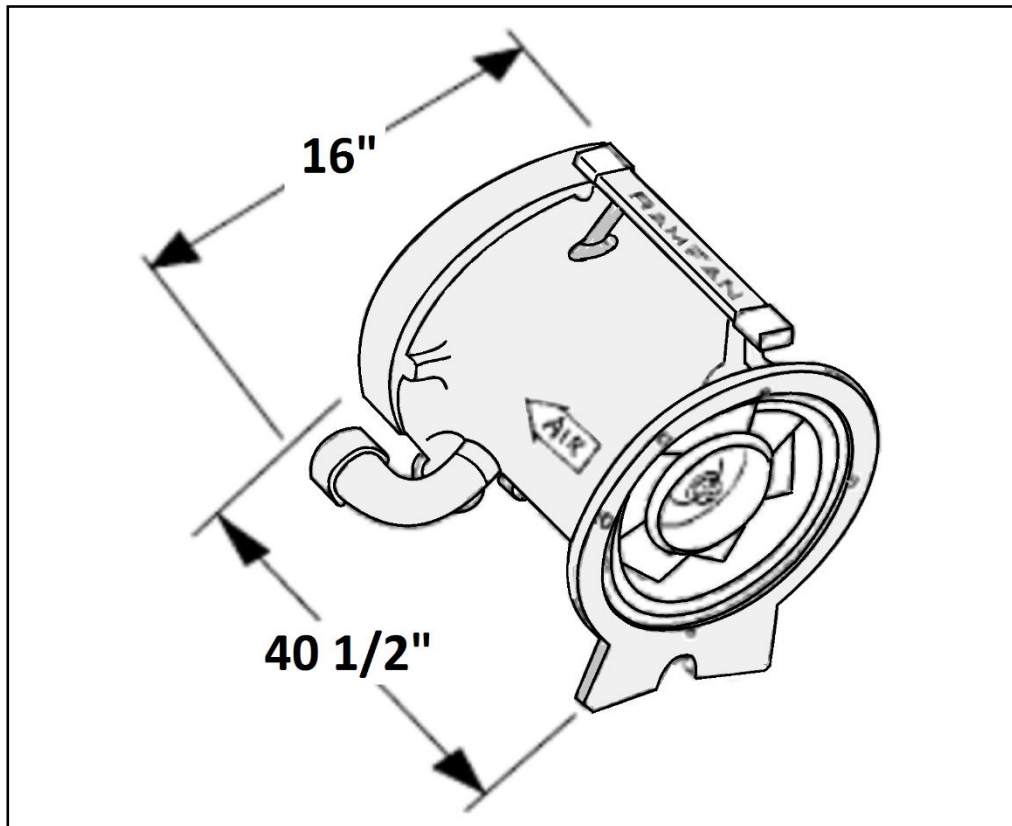


Figure K-13. Water driven fan

**WARNING**

Exhausting gases through duct can create a static electric charge. It is important to ensure positive contact to ground to avoid unwanted discharge while operating around explosive atmospheres.

**Portable Electric Desmoking Fans**

K-55. The medium capacity fan is a portable electric fan designed to be used by damage control personnel for rapidly desmoking compartments in areas where exhaust ducting is not needed. It produces a tight spiral of air or smoke to prevent recirculation into the area being desmoked.

K-56. The portable desmoking fan should be inspected for damage before use. Careful inspection of the electrical cord is necessary to prevent shock hazards, and the tamper seal on the electric motor must be intact. If this seal is broken, the fan must not be used in any explosive environments. Ensure that the screen guards are in place before operation.

K-57. The portable electric desmoking fan operates using 115 volts ac; simply plug it in and turn it on. Damage control plates and your Main Space Fire Doctrine will assist you in determining the most efficient desmoking methods. Additional guidance may be found in Naval Ships' Technical Manual, chapter 555, volume 1.

K-58. Cleaning, inspection, and testing of these fans must be accomplished according to PMCS and the manufacturer's technical manual.

K-59. The intent of this chapter is to give you a basic overview of certain portable equipment. To become proficient, you must train with this equipment under proper supervision and familiarize yourself with the technical manuals.

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## Appendix L

# Confined Space Entry

This appendix outlines procedures established in the US Army Combat Readiness Center's Confined Spaces Program for the identification, preparation, testing, entry into and rescue from confined spaces within the Army watercraft fleet. On Army watercraft, when in port, Confined Space Entry procedures can only be initiated and performed by approved shore side personnel. Confined Space Entry procedures must be carried out properly by the vessel's crew when training for emergencies (i.e., fire or damage control) at sea, in port, and during actual events. Each ocean going Army watercraft has trained personnel and the equipment authorized to effectively evaluate the situation, plan and conduct the entry, perform any necessary personnel rescue, and completely clear the affected spaces to return those areas to inhabitable use.

### WARNING

**ALL SPACES ARE HOT WORK PERMIT-REQUIRED SPACES FOR WELDING OPERATIONS.**

## CONFINED SPACE TERMS AND RESPONSIBILITIES

L-1. Listed below are the terms and responsibilities associated with working in confined spaces.

### TERMS

L-2. Adjacent spaces. Spaces bordering a subject space in all directions, including all points of contact, corners, diagonals, decks, tank tops, and bulkheads.

L-3. Attendant. An individual stationed outside, a permit required confined space who monitors the authorized entrants and who performs all duties assigned in accordance with the unit's permit space program.

- Authorized entrant. An individual who has attended the required Confined Space Entry training either at the U.S. Army Transportation School or National Fire Protection Association (NFPA) taught Competent Person course and is trained to enter a confined space.
- Confined space. A confined space is one that meets the following conditions:
  - Large enough that an individual can bodily enter and perform assigned work.
  - Has limited or restricted means for entry or exit (for example, tanks, vessels, vaults, pits, fuel cells, all rub railings, sealed ramp compartments, kort nozzles and rudders, stanchions and handrails, mast framework, and any sealed spaces onboard all watercraft).
  - Not designed for continuous occupancy.
- Enclosed Space. Any space, other than a confined space, which is enclosed by bulkheads and overheads. It includes cargo tanks, tanks quarters, and machinery and boiler spaces.
- Emergency. Any occurrence (including any failure of a hazard control or monitoring equipment) or event (internal or external) to the permit space that could endanger entrants.
- Engulfment. The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

- Entry. Any action resulting in any part of an individual's body breaking the plane of any opening of the confined space, and includes any work activities inside the confined space.
- Entry permit. The written or printed document that is provided by the Unit Safety Office to allow and control entry into a permit space and that contains the information specified in this appendix.
- Entry supervisor. The person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required.
- Hazardous atmosphere. An atmosphere presenting a potential for death, disablement, injury, or acute illness from one or more of the following causes:
  - A flammable gas, vapor or mist in excess of 10% of its lower explosive limit (LEL).
  - An oxygen deficient atmosphere containing less than 19.5% oxygen by volume or an oxygen enriched atmosphere containing more than 22% oxygen by volume.
  - Airborne combustible dust at a concentration that meets or exceeds its LEL (airborne combustible dust which obscure vision at five feet or less).
  - Any other atmospheric condition that is immediately dangerous to life or health.
- Hot work permit. The written authorization to perform operations (such as welding, grinding, cutting, electrical drilling,) is capable of providing a source of ignition.
- Immediately dangerous to life or health. Any atmosphere that poses an immediate threat to life or that is likely to result in acute or immediate severe health effects.
- Lockout-tagout. Placing locks and tags on energy isolating devices (e.g. breaker boxes, control switches, valves,) to prevent the system from being re-energized while work is still being performed by personnel.
- Oxygen deficient atmosphere. An atmosphere having an oxygen concentration of less than 19.5 percent by volume.
- Oxygen enriched atmosphere. An atmosphere that contains 22.0 percent or more oxygen by volume.
- Permit-required confined space. A space that meets the definition of a confined space and has one or more of these characteristics:
  - Contains or has a potential to contain a hazardous atmosphere.
  - Contains a material that has the potential for engulfing an entrant.
  - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section.
  - Contains any other recognized safety or health hazard.
- Permit required confined space program. The Command's overall program for controlling, and, where appropriate, for protecting personnel from permit space hazards and for regulating personnel entry into permit spaces.
- Prohibited condition. Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.
- Rescue teams. The personnel designated to rescue personnel from permit spaces.
- Retrieval system. The equipment used for non-entry rescue of persons from permit spaces.
- Testing. The process by which the hazards, that may confront entrants of a permit space, are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

## **DUTIES AND RESPONSIBILITIES**

- L-4. The following identifies the duties and responsibilities of those involved with confined space entry:
- Commanders. Commanders are responsible for the following:
    - Establishing a confined space entry SOP within each organization conducting entry operations.
    - Ensuring recommended equipment to support confined space entry operations is purchased and maintained.

- Ensuring personnel assigned confined space entry duties are adequately trained and certified.
- Maintaining an inventory of all confined spaces within the organization.
- Establishing risk approval procedures within the organization.
- Appoint Confined Space Entry Supervisor. This is usually the Vessel Support Office, Chief Engineer, or other confined space trained personnel.
- Entry Supervisor. The entry supervisor is responsible for the following actions:
  - Before Entry, the supervisor verifies that the confined space entry permit is filled out completely, all steps listed on it are taken, and then signs the entry permit. Use General Services Administration (GSA) Form 3625, *Confined Space Entry Permit*, which can be found on the APD web site under “Miscellaneous Forms”.
  - During Entry, the entry supervisor checks conditions to make sure they stay safe throughout the work.
  - If conditions become unsafe, the permit is cancelled and everyone is ordered out of the space.
  - The entry supervisor sees that any unauthorized people are removed.
  - When the work is finished, the entry supervisor cancels the permit and concludes the operation.
- Entrant. The entrant must:
  - Know hazards that may be faced during entry.
  - Be able to recognize signs or symptoms of hazard exposure and understand the consequences of such exposure.
  - Use equipment properly.
  - Maintain communication with the attendant.
  - Alert the attendant to hazards discovered while in the space.
  - Exit the space quickly when required.
- Attendant. The attendant must:
  - Know hazards that may be faced during entry.
  - Be able to recognize signs or symptoms of hazard exposure.
  - Maintain accurate entrant identification.
  - Remain outside the space at all times.
  - Maintain communication with the entrant and be able to communicate with the entry supervisor when needed.
  - Monitor entry activities.
  - Summon rescue services when needed.
  - Prevent unauthorized entry.
  - Perform non-entry rescue.
  - Perform no conflicting duties.

## SAFETY

L-5. In the past, over 60 percent of all fatalities in confined spaces were untrained rescuers. The primary cause of injury or death in confined spaces is asphyxiation. The second leading cause is fire. Implementation of the U.S. Army Combat Readiness Center’s Confined Spaces Program standard and application of these procedures will greatly reduce the potential for loss of life during entry into confined spaces.

## CONFINED SPACE CLASSIFICATION

L-6. Each space must be evaluated on its own merit at the time of entry. Despite some leeway in the federal standards, you must treat all spaces as permit spaces prior to entry. This means that prior to entry, an entry supervisor will verify and document test results for oxygen content, flammability, and toxicity as well as evaluating other potential hazards. The entry supervisor may modify entry procedures based on this initial evaluation by classifying the space as non-permit. However, the space must clearly demonstrate no potential

for developing a serious hazard during the work process. If a space is designated as non-permit, initial atmospheric test results must be documented and maintained on file for one year following the entry.

## **PREVENTING UNAUTHORIZED ENTRY**

L-7. Each organization responsible for entering confined spaces must maintain an inventory of such spaces. The inventory must be organized so that the locations of referenced spaces are easily identified. All spaces that have the potential to contain atmospheric or other serious hazards must be marked using a “Danger Confined Space” sign and secured, if possible, to prevent unauthorized entry. All entries must be approved by a certified entry supervisor. During entry operations, an attendant will be positioned at the point of entry to ensure that only authorized entrants are allowed in the space. Attendants will summon the entry supervisor should unauthorized individuals interfere with safe operations. The entry supervisor will remove such individuals. To aid in preventing unauthorized entry, a safe zone must be identified around the point of entry using barricade tape or other means to warn individuals of a restricted area. Also, a “Danger Confined Space” sign must be posted at the point of entry.

## **CONFINED SPACE ENTRY EQUIPMENT**

L-8. Organizations required to enter confined spaces will purchase and maintain a meter capable of measuring oxygen, flammability, and any toxic gases that can reasonably be expected to exist in the space atmosphere. Army watercrafts with confined spaces are authorized to acquire the necessary equipment. DD Form 314 (*Preventive Maintenance Schedule and Record*), or in accordance with the manufacture’s recommended calibration guidance, must be maintained on all meters to document periodic, unit level calibration. Calibration must be done prior to each daily use, but will not exceed monthly if the meter is not in use. Organizations must ensure that calibration gas and replacement sensors are available when needed. Other equipment required for safe entry is identified on the entry permit and must be maintained and issued. Should such equipment not be available in the organization, entry may not proceed until it is obtained. Such equipment includes tripod with winch, lifeline and harness, non-sparking tools, lighting approved for hazardous atmospheres, ventilation blower, eye protection, hearing protection, gloves, and so on.

## **EVALUATING CONFINED SPACE HAZARDS**

L-9. Use the following steps to evaluate confined space hazards:

- Step 1- The confined space must meet the following atmospheric criteria prior to entry:
  - Percent of oxygen not below 19.5 percent or above 22 percent.
  - Percent of LEL not above 10 percent.
  - Parts per million of carbon monoxide not above 35 parts per million (ppm).
  - Other atmospheric hazards not above the published permissible exposure limit (PEL). See the material safety data sheet for specific contaminants.

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**Note.** Should there be an indication that other atmospheric hazards may exist but cannot be identified at the unit level, contact the supporting medical department activity for a consultation.

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- Step 2- Visual inspection of the space prior to entry should identify other hazards that may exist. These may include noise, fall hazards, entrapment hazards, heat/cold, high pressure lines, inadequate lighting, and chemicals, piping carrying hazardous materials, moving machinery, electrical hazards, biohazards, radiation hazards, and so forth.

## **CONTROLLING CONFINED SPACE HAZARDS**

L-10. The goal of each entry is to have optimum conditions. This means you should always strive to have 20.8 percent oxygen, 0 percent LEL, 0 ppm CO, 0 ppm of other hazardous gases, and fully control all other hazards. The entry supervisor is trained to establish these controls. Ventilation is the primary means of eliminating atmospheric hazards. The following are Basic ventilation standards:

- Meter readings must be taken prior to and after ventilating to evaluate the effectiveness.



- Normally, oxygen hazards will be controlled by blowing fresh air into the space and flammable/toxic hazards will be controlled by exhausting contaminated air from the space.
- If hazardous conditions are being created during the work process, ventilation may be needed continuously during the entry.
- Single point hazards such as welding and burning can best be controlled using local exhaust ventilation.
- When hazardous gases are heavier than air, exhaust low in the space and replace air high in the space. When hazardous gases are lighter than air, exhaust high in the space and replace air low in the space. Refer to the contaminants vapor density on the Material Safety Data Sheet (MSDS) for determination.
- Should there be any doubt about the use of ventilation or its effectiveness, contact the supporting medical facility for a consultation.

L-11. Isolation of hazardous conditions is necessary before entry is allowed. Isolation is the process of ensuring that space remains free from release of energy or other hazards while the space is open for entry operations. The entry supervisor is responsible for evaluating hazards and the most effective means of isolation. Some controls include:

- Blanking and blinding.
- Removal of pipe sections.
- Double block and bleed.
- Lockout and/or tagout.
- Disconnecting mechanical linkages.
- Elimination of other hazards through cleaning, inserting, removal, guarding, reengineering, and soon should be the goal of the entry supervisor.

L-12. If hazards cannot be fully controlled, protective equipment must be used. Controls identified on the entry permit must remain in place during the work processor the entry must be terminated.

## HOT WORK

L-13. Hot work includes any spark, flame, or extreme heat producing work such as welding, burning, brazing, grinding, cutting, chipping, use of tools that produce an electrical arc, and so on. The following procedures will be used to protect against the possibility of fire or explosion when performing hot work in or adjacent to confined spaces.

- A Marine Chemist, Army authorized person, or a Certified Industrial Hygienists will decide what work constitutes hot work prior to entry.
- If atmospheric testing shows or through evaluation of the work process a flammable environment is expected, both an entry permit and a hot work permit must be completed before work can begin.
- Hot work will not be accomplished in or near spaces containing more than 10 percent of LEL.

L-14. Organizations must make every attempt to engineer potentially flammable environments to 0 percent LEL before work commences or to fully control the potential hazard. This will be done by:

- Identifying all sources of flammable/combustible liquids, gases, and solids and using an acceptable means of isolating such sources from the space.
- Inserting spaces with a non-flammable inert gas if deemed appropriate by the entry supervisor. (Keep in mind that inserting creates an oxygen deficient atmosphere.).
- Cleaning and purging the space to remove flammable/combustible materials and residue.
- Covering combustible surfaces with a welding blanket or other suitable barrier.
- Using non-sparking tools and electrical appliances approved for the class and group of hazardous location expected.
- Continuously monitoring LEL levels when the work process may produce a flammable/combustible atmosphere.
- Evaluating all adjacent spaces to ensure that there is no potential for igniting products in those areas.

- Having adequate fire extinguishing equipment on hand.
- Using a fire watch when necessary.

### **EMERGENCY RESPONSE**

L-15. The following procedures will be used for an emergency response:

- The entry team is trained to identify symptoms of hazard exposure. The goal of each entry is to conduct self-rescue in the case of any incident.
- The attendant or entrant, once an incident occurs, is obligated to clear the space immediately.
- If a meter alarm sounds with an entrant in the space, the space must be cleared immediately without first evaluating the reason for the alarm.
- Should an injury occur in the space and the entrant cannot conduct a self-rescue, the attendant must initiate a rescue by contacting the installation fire department or other rescue service.
- Prior to the rescue team arriving, the attendant will notify the entry supervisor and may attempt a non-entry rescue; however, the attendant may not enter the space.

### **CONFINED SPACE ENTRY TRAINING**

L-16. Minimum standards for confined space entry training. Each confined space entry team member must be trained. Initial Certification training is conducted at the U.S. Army Transportation School or National Fire Protection Association (NFPA) taught Competent Person course. All training will be properly documented to include individual student identification.

L-17. Permits will be used according to the following.

- An entry permit will be used to document results of atmospheric tests and control safe entry.
- Only certified entry supervisors may approve entry permits.
- Entry permits will be approved for the minimum time necessary to complete operations.
- The original permit will be posted at the point of entry while work is in progress. – A copy of the permit will be maintained by the organization for three months following the entry.
- Only those entrants identified on the permit may enter the space.
- Hot work may require special precautions that are not identified on the entry permit. If this occurs, the hot work permit will be used in conjunction with the entry permit. In such cases, the entry permit and the other permit will be posted at the point of entry.

### **COMMUNICATION**

L-18. The entry supervisor will establish procedures for communication relative to each entry. Continuous communication between the entrant and attendant is required and emergency communication is required between the attendant and the rescue team and entry supervisor. Communication may be visual, verbal, signals, and so forth, but must be identified on the entry permit.

### **CONTRACTORS**

L-19. Each organization must accomplish the following prior to contractor entries into confined spaces managed by this Command:

- Inform the contractor of permit program requirements.
- Apprise the contractor of safety precautions and procedures specific to the confined space being entered.
- Apprise the contractor of emergency response procedures on the installation.

### **CONCLUDING CONFINED SPACE ENTRIES**

L-20. At the completion of work, the following will be done:

- Cancel the permit and file it for three months

- Close the space and ensure that it is identified as a restricted area by having a “Danger Confined Space” sign posted at the point of entry

## **HOT WORK IN CONFINED OR CLOSED SPACES**

L-21. Hot work in the context of gas free engineering includes the following:

- Flame heating, welding, torch cutting, brazing, or carbon arc gouging. Chipping, electric drilling, grinding, electric wire brushing.
- Any operation producing temperatures of 204.4 degrees Celsius (400 degrees Fahrenheit).
- Any operation occurring in the presence of flammable materials or in a flammable atmosphere which requires the use or presence of an ignition source. Examples of such work include the following:
  - Spark-producing or static discharge.
  - Friction.
  - Open flames or embers.
  - Impact.
  - Non-explosion-proof equipment (such as lights, fixtures, or motors).

### **CAUTION**

When open flame or heat producing work such as welding, cutting, or brazing is to be conducted, the worksite, regardless of the location, is to be inspected by the gas free engineer, safety NCO, fire department, or local approving authority as required by local SOP.

L-22. The provisions in this section apply to all hot work performed in confined or enclosed spaces, machinery rooms, bilges, and other locations proximate to flammable atmospheres (such as near fuel tank vents and sounding tubes). This section also applies to hot work performed on closed structures or containers such as pipes, drums, ducts, tubes, jacketed vessels, and similar items.

## **CLEANING AND VENTILATING FOR HOT WORK**

L-23. Before hot work is begun in a confined or enclosed space, the space shall be tested, inspected, emptied of flammable cargo, cleaned, ventilated, and certified safe for hot work. Extraneous flammable or combustible materials such as scrap wood, paper, ropes, or rags shall be removed from the space. Combustible materials that cannot be removed shall be adequately protected. Ventilation ducting shall be made of noncombustible metal, of flexible construction, and free from hazardous combustible residues.

## **FIRE WATCH**

L-24. When open flame or heat-producing work such as welding, cutting, or brazing is to be conducted, establish a trained fire watch at the worksite.

L-25. When hot work may transmit fire hazards to other spaces by overheating the connecting deck, overhead, or bulkheads, provide fire watches on both sides of the hot deck, overhead, or bulkheads.

L-26. Fire watch communications will enable the fire watch to report hazardous conditions on the opposite side of separating structures and provide a signal to stop hot work. Fire watches on both sides of the separating structure shall have, and know how to use, fire extinguishing equipment suitable to the exposure. Fire watches shall be equipped with personnel protective equipment as required for the operation being conducted (such as goggles, helmet, approved respiratory protective devices, and fire retardant clothing).

L-27. After completion of the hot work operation, fire watches shall remain on station for a minimum of 30 minutes; ensure the area is cool to the touch, and that no smoldering embers remain.

## FIRE EXTINGUISHING EQUIPMENT

L-28. Fire extinguishing equipment shall be provided which is suitable for the nature and amount of flammable or combustibles present. Never use vaporizing liquid extinguishers in confined or enclosed spaces.

L-29. Use CO<sub>2</sub> extinguishers only after determining that the extinguisher is appropriate for the exposure. Also determine whether the displacement of oxygen by discharge of CO<sub>2</sub> into the space is likely to cause a hazard to personnel.

L-30. Water extinguishers or fire hoses equipped with Vari-nozzles, fog nozzles, or fog applicators are the most suitable fire extinguishing equipment for hot work in the presence of ordinary (class A) combustible material, flammable residues, coating, or insulation.

L-31. Evaluate fire extinguishing equipment for the following:

- Ability to suppress the fire.
- Hazards that the extinguishing agent might create in the space.
- Capacity of the equipment compared to the fire potential. Fire hoses equipped with a Vari-nozzle, fog nozzle, applicator, or portable fire extinguisher are acceptable. The nature of the space or ship may restrict selection of fire equipment.

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*Note.* Class A combustibles are those which leave embers and must therefore be cooled throughout the entire mass.

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## HOT WORK LOCATIONS

L-32. Prior to beginning hot work, an assessment of potential hazards must be made at each hot work location. The following, although not all inclusive, provides guidance regarding what hazards to expect.

- Boundary Spaces. When hot work is to be performed on fuel tanks, associated vent spaces, or other spaces containing flammables (such as paint lockers and flammable liquid storerooms), the adjacent spaces above, below, and on all sides (boundary spaces) shall first be inspected and tested, cleaned, and ventilated or inserted as appropriate, then certified "SAFE FOR HOT WORK".
- Pipes, Tubes, and Coils. Hollow connections to a space can present the same hazards as the space itself. Pipes, tubes, and coils or similar items which service, enter, or exit a confined or enclosed space shall be flushed, blown, purged, or otherwise cleaned and certified Safe for Hot Work before the performance of hot work on such items. If not so treated and certified, the certificate for the space shall be marked Not Safe for Hot Work. Valves to pipes, tubes, or similar items shall be dosed, the pipes blanked off, and tagged out, following the provisions of the Ship's Tagout Procedures, to prevent inadvertent discharge or backflow of materials into the space.
- Hot Work on Closed Containers or Structures. Prior to beginning hot work on hollow structures, drums, containers, jacketed vessels, or similar items, the items shall be cleaned, flushed, purged, made inert, filled with water, or otherwise made safe. The items shall be inspected, cleaned, tested, and certified before performing hot work. Items which are dosed and subject to pressure buildup from any application of heat shall be vented to relieve any pressure created by the hot work. The method of venting shall be selected to prevent ignition or explosion during the venting process.
- Hot Work near Preservative Coatings. Characteristics of a particular coating determine the procedures and precautions for hot work near that coating.
- Flammable Coatings. Flammable coating hot work requirements are as follows:
  - Determine the flammability of coatings before starting hot work. Remove combustible coating from the hot work area to a distance sufficient to prevent ignition or outgassing (from temperature increase) at least 4 inches on all sides from the outer edge of the hot work.
  - Never use flame or uncontrolled heat for stripping flammable coating. Test continuously for flammable atmospheres during hot work. Where significant outgassing is detected, stop hot work and further strip the coating. Start artificial cooling methods, such as wetting down, to prevent temperature increases in the un-stripped areas.

- Shield flammable coatings from slag or sparks in the area of the hot work. Wet down surrounding areas or cover with netted fire retardant cloth. Ventilate area, if applicable.
- At a minimum, keep a 1-inch fire hose with a Vari-nozzle, fire nozzle, or fog applicator in the immediate vicinity, charged, and ready for instant use, except where prohibited by the nature of the space or ship.
- Toxic Coatings. Before hot work, strip any coating which becomes toxic when heated to at least 4 inches beyond the area that will be heated. Equip personnel with airline respirators or equivalent respiratory protection. Ventilate to remove toxic fumes or vapors from the space.
- Hot Work near Damaged Surfaces. Tank walls and coating deformities may carry toxicants and other hazards. Blisters, scales, and similar formations inside tanks that have held flammable materials may, even after cleaning and ventilating, hold flammable residues.

L-33. The following is a list of considerations when planning for hot work:

- Determine whether any previous tank contents may have left hazardous residues.
- Assess the possibility of a surface flash which would involve the entire space.
- Clean Scales or Blisters. Consider the following when cleaning scales or blisters:
  - Remove scales or blisters which contain highly flammable residues (flashpoint 37.8 degrees Celsius (100 degrees Fahrenheit) such as gasoline or jet propulsion (JP)-4 fuels from the entire space before hot work.
  - Clean away scales or blisters containing less flammable residues (flashpoint above 37.8 degrees Celsius (100 degrees Fahrenheit) such as fuel oil or JP-5 fuel) to a distance of 4 inches on all sides from the outer edge of the hot work. In all cases, the area cleaned shall be sufficient to prevent out gassing from surrounding areas and to prevent ignition of residues.
  - Clean or protect areas below the hot work. Use screens, fire retardant cloth, or devices to capture sparks and slag.
  - Wet down areas around hot work to reduce the residue vaporization and to prevent small fires and flashes.
  - Assign fire watches with equipment to extinguish any resulting fire.
- Hot Work near pressurized systems. Before beginning hot work, depressurize nearby pressurized systems (such as hydraulics or Freon). Protect piping, fittings, valves, and other system components from contact with flames, arcs, slag, or sparks. Clean space and remove contaminants before hot work.

### WARNING

**WHEN SUBJECTED TO HIGH TEMPERATURES, HYDRAULIC FLUID CAN DECOMPOSE AND PRODUCE HIGHLY TOXIC BY-PRODUCTS. NONCOMBUSTIBLE INSULATION SUCH AS FIBERGLASS MAY HAVE COMBUSTIBLE BACKING OR ADHESIVE MATERIALS.**

- Hot Work near Insulation. Conduct hot work carefully near combustible insulation. Some insulation materials may be ignited by welding, slag, or other short-duration exposure to ignition sources. Foam insulation materials are particularly likely to ignite and generate toxic combustion gases. The following are procedures for hot work near insulation:
  - Remove insulation from the area of hot work.
  - Wet down non-removable insulation with water then cover the insulation with water soaked, fire-retardant cloth.
  - Station a fire watch with a charged 1-inch fire hose, ready for use in the immediate area.
- Hot Work near Ammunition and Explosives. The following procedures are for hot work near ammunition or explosives:
  - Remove ammunition and explosives from the area of hot work.

- Ventilate the area of the hot work.

## **HAZARDOUS BY-PRODUCTS**

L-34. Welding, cutting, heating, or burning in the presence of certain materials (such as adulate fluids, Freon, chlorinated or solvents) can cause decomposition and produce hazardous by-products. Ensure that hot work is not conducted on or near such materials. Keep welding or cutting operations, which produce high levels of ultraviolet radiation, at least 200 feet from exposed chlorinated solvents.

## **GAS WELDING AND CUTTING OPERATIONS**

L-35. The following shall be observed when performing gas welding or cutting operations:

- Transport, handle, and store compressed gas cylinders in accordance with the Code of Federal Regulations.
- Keep compressed gas cylinders or gas manifolds, used in welding and cutting operations, out of confined or enclosed spaces. Place them outside the space in open air, away from any fire, explosion, or emergency situation.
- Special care should be taken when working around electrical components.

## **COMPRESSED GAS CYLINDER STORAGE REQUIREMENTS**

L-36. Compressed gas cylinders addressed here consist of any container which has a compressed gas, immaterial of size and content. Cylinders shall be stored at least 20 feet (6.1 m) from highly combustible materials such as oil or fuel. Cylinders should be stored in definitely assigned places away from stairs or gangways. Assigned storage places shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers. Cylinder storage racks shall consist of both a raised area to set the cylinder into and a securing bracket near the top portion of the bottle. There should be no metal to metal contact between the cylinder and the storage rack. The cylinder valve head should have the screw type guard cap in place except when the cylinder is being used to provide its contents for its designed purpose. Installed or stowed compressed cylinders should be visually inspected monthly hydrostatically tested every 12 years or removed from service.

# Glossary

<b>AC</b>	Active Component
<b>AFFF</b>	aqueous film forming foam
<b>AMTOR</b>	amateur teleprinting over radio
<b>AR</b>	Army Regulation
<b>ATP</b>	Army Techniques Publication
<b>BGAN</b>	Broadband Global Area Network
<b>BII</b>	basic issue item
<b>CBRN</b>	chemical, biological, radiological, and nuclear
<b>CES</b>	coast earth station
<b>CFR</b>	Code of Federal Regulations
<b>COSAL</b>	coordinated shipboard allowance list
<b>COSPAS</b>	Cosmitscheskaja Sistema Poiska Awarinitsch Sudow (Russian satellite system)
<b>CO2</b>	carbon dioxide
<b>DA</b>	Department of the Army
<b>DOD</b>	Department of Defense
<b>DSC</b>	digital selective calling
<b>EEBD</b>	Emergency Escape Breathing Device
<b>EPIRB</b>	Emergency Position Indicating Radio Beacon
<b>EWARP</b>	emergency water activated repair patch
<b>FCC</b>	Federal Communications Commission
<b>FEC</b>	forward error correction
<b>FFE</b>	firefighter's ensemble
<b>FM</b>	field manual
<b>G3E</b>	phase modulation designation code for the SCR
<b>GEOSAR</b>	geostationary
<b>GeoSTAR</b>	Geostationary Synthetic Thinned Aperture Radiometer
<b>GHz</b>	gigahertz
<b>GMDSS</b>	Global Maritime Distress and Safety System
<b>GOES</b>	Geostationary Operational Environmental Satellite
<b>GPA</b>	ground precautionary action
<b>GPS</b>	Global Positioning System
<b>HAZMAT</b>	hazardous material
<b>HF</b>	high frequency
<b>HFC</b>	Hydro Fluoro Carbon
<b>IAW</b>	in accordance with
<b>IMCO</b>	Interantional Maritime Consultative Organization
<b>IMO</b>	International Maritime Organization
<b>INMARSAT</b>	International Maritime Satellite
<b>ITU</b>	International Telecommunications Union

<b>JSETS</b>	Joint Search and Rescue Satellite-Aided Tracking (SARSAT) Electronic Tracking System
<b>JP</b>	joint publication
<b>JP5</b>	jet propulsion fuel, type 5
<b>kHz</b>	kilohertz
<b>LCD</b>	liquid crystal display
<b>LSV</b>	logistics support vessel
<b>LT</b>	large tugboat
<b>MA</b>	maintenance action
<b>MDMP</b>	military decisionmaking process
<b>METAREA</b>	meteorological area
<b>MDS</b>	mission design series
<b>MDSM</b>	mission design series model
<b>mw</b>	megawatt
<b>MES</b>	mobile earth station
<b>MF</b>	medium frequency
<b>MHz</b>	megahertz
<b>MI</b>	maintenance information
<b>Mk7</b>	Navy mark 7 life raft
<b>MOBI</b>	man overboard indicator
<b>MOPP</b>	mission oriented protective posture
<b>NAVAREA</b>	navigational area
<b>NAVAIDS</b>	Navagational Aid System
<b>NAVTEX</b>	navigational telex
<b>NCS</b>	Network Coordination Station
<b>NFPA</b>	National Fire Protection Association
<b>NFTI</b>	Naval fire fighter's thermal imager
<b>NH</b>	national hose
<b>NM</b>	nautical miles
<b>NMC</b>	non-mission capable
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NOC</b>	network operations center
<b>NSN</b>	national stock number
<b>OBA</b>	oxygen breathing apparatus
<b>OSHA</b>	Occupational Safety and Health Administration
<b>PECU</b>	portable exothermic cutting unit
<b>PEL</b>	permissible exposure limit
<b>PFD</b>	personal flotation device
<b>PKP</b>	purple potassium (K) powder
<b>PMCS</b>	preventive maintenance checks and services
<b>PML</b>	personnel marker light
<b>POP</b>	packet oriented protocol



<b>PRMS</b>	personal recovery mission software
<b>PSI</b>	pounds per square inch
<b>PVC</b>	polyvinyl chloride
<b>RC</b>	Reserve Component
<b>RCC</b>	Rescue Coordination Center
<b>SAR</b>	Search and Rescue
<b>SARSAT</b>	Search and Rescue Satellite-Aided Tracking
<b>SART</b>	Search and Rescue Transponder
<b>SATCOM</b>	satellite communications
<b>SCBA</b>	Self Contained Breathing Apparatus
<b>SCR</b>	Survival Craft Radio
<b>SDS</b>	safety data sheet
<b>SES</b>	ship earth station
<b>SOLAS</b>	safety of life at sea
<b>SOP</b>	standing operating procedure
<b>SOU</b>	safety of use
<b>SSDG</b>	small scale distributed generation
<b>ST</b>	small tugboat
<b>TM</b>	technical manual
<b>U.S.</b>	United States
<b>USCG</b>	United States Coast Guard
<b>VHF</b>	very high frequency
<b>VTS</b>	Vessel Traffic Service
<b>WOAC</b>	Warrant Officer Advanced Course
<b>WOBC</b>	Warrant Officer Basic Course
<b>WWS</b>	water washdown system

## SECTION II – TERMS

None.

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These documents must be available to intended users of this publication.

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None.

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**15 September 2015**

By Order of the Secretary of the Army

**MARK A. MILLEY**  
*General, United States Army*  
*Chief of Staff*

Official:

A handwritten signature in black ink, appearing to read "Gerald B. O'Keefe". The signature is fluid and cursive, with the first name "Gerald" being the most prominent.

**GERALD B. O'KEEFE**  
*Administrative Assistant to the*  
*Secretary of the Army*  
1520902

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